AF2T2EA – An Illustrative Example of the C2 Conceptual Model

by Dr. Paul W. Phister, Jr.
AFRL/IFB
AF Research Laboratory/Information Directorate
26 Electronic Parkway, Rome NY, 13441-4514
Paul.phister@rl.af.mil

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JUN 2006		**00-00-2006 to 00-00-2006**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
AF2T2EA - An Illustrative Example of the C2 Conceptual Model	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air Force Research Laboratory,Information Directorate,26 Electronic Parkway,Rome,NY,13441-4514**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**57**	

AF2T2EA – An Illustrative Example of the C2 Conceptual Model

by Dr. Paul W. Phister, Jr.
AFRL/IFB
AF Research Laboratory/Information Directorate
26 Electronic Parkway, Rome NY, 13441-4514
Paul.phister@rl.af.mil

Abstract

Over the past three years, a NATO panel (SAS-050) has developed the first version of a Command and Control (C2) Conceptual Model. The Conceptual Model's purpose is to support the exploration of new, networked-enabled approaches to C2 and compare their characteristics, performance, effectiveness, and agility to traditional approaches to C2. The Air Force's "Kill Chain" is a lengthy process that's subdivided into seven "events", namely: anticipate, find, fix, track, target, engage, and assess (AF2T2EA). As an illustrative example of the C2 Conceptual Model, the Model's attributes were applied to each of the seven areas in two test cases. Test case one, the Conceptual Model's variables were mapped into each of the AF2T2EA events via five bins (environment, information, awareness, understanding and decision). The result represented the Conceptual Model's "process view". Test case two, the Conceptual Model's variables were mapped into a set of AF2T2EA required capabilities. For a sub-set of the AF2T2EA capabilities, the Conceptual Model variables were evaluated as to having a high, medium or low correlation to the stated AF2T2EA capabilities. The result represented the Conceptual Model's "value view". Both test cases yielded expected results reaffirming the Conceptual Model's variable listing did not have any major discrepancies.

Introduction

Ever since the 1999 publication of the book "Network Centric Warfare," countries and organizations have embarked on a journey of transformation to take full advantage the concepts and capabilities of the Information Age. Whether it is called Network-Enabled Capability, as it is in NATO, Network Centric Operations, Network Enabled Defense, or Edge Organizations, this transformation is predicated on a set of network-centric tenets[1].

These tenets that form the intellectual foundation for these on-going transformations are: a) a robustly networked force (enterprise) enables the wide spread sharing of information; and, b) wide spread information sharing and collaboration in the information domain improves the quality of awareness, shared awareness, and collaboration (C2 and operations processes). This, in turn, enables self-synchronization: the result is a dramatic improvement in operational effectiveness and agility.

Over the past three years, the NATO panel (SAS-050) has developed the first version of a C2 Conceptual Model, whose resultant top level is shown in Figure 1.

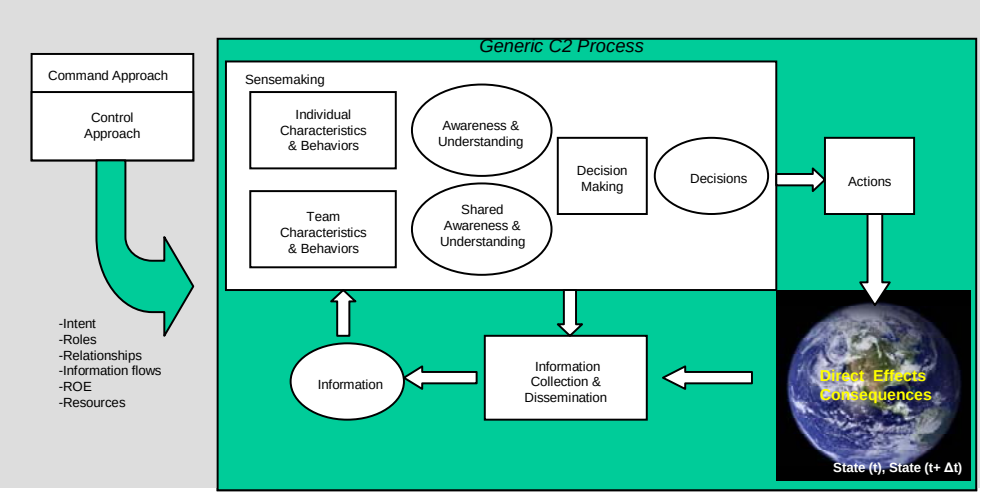


Figure 1: Top Level View of the C2 Conceptual Model

[1] Final Report, SAS-050, March 2006.

The goals and objectives of the SAS-050 panel were to: a) develop a conceptual model of key variables and the relationships among them; b) identify tools that can explore the nature of the relationships among the variables; c) apply, as a test case, the model and tools; d) conduct a peer review of the model; and, e) disseminate model and the findings.[2]

The purpose of the C2 Conceptual Model developed by SAS-050 is to support the exploration of new, networked-enabled (or network-centric /power to the edge) approaches to command and control and compare their characteristics, performance, effectiveness, and agility to traditional approaches to command and control. Specifically the model must be able to trace the implications of certain value ranges for the C2 approach variables (those that correspond to selected C2 approaches)[3]. The resultant C2 Conceptual Model reference model has three layers as shown in Figure 2[4].

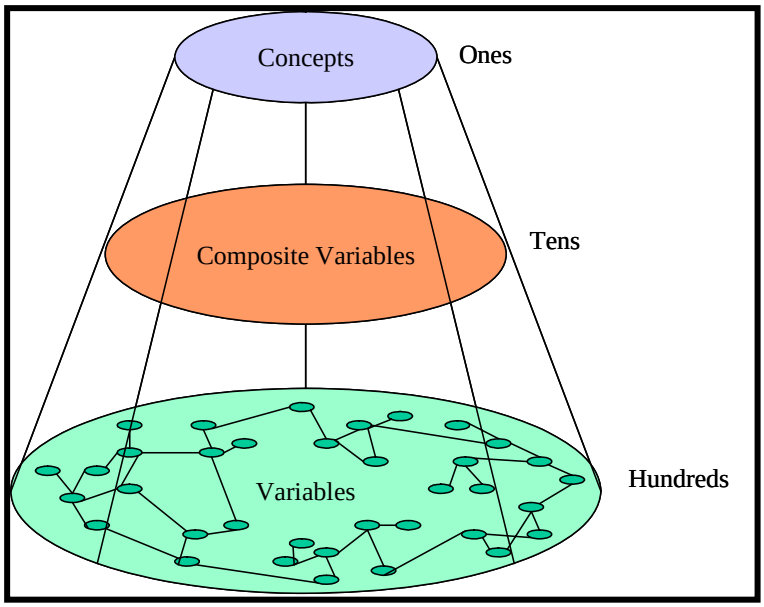


Figure 2: C2 Conceptual Model Reference Model Layers

The C2 conceptual Model contains three different, but complementary views of the domain of interest. The first is the "event view"; which describes the state of the "system" at any given point in time. The second is the "process view"; which describes how state changes occur in the system. The third view is the "value view"; which represents changes in measures of performance, effectiveness, etc. This view documents goals and objectives, or more generally why one cares about the "system performance" in the first place.[5]

As part of the C2 Conceptual Model's development, an illustrative example was explored to determine if there were any shortcomings or obvious discrepancies of the model. The Air Force's AF2T2EA "Kill Chain" process was chosen as the illustrative example.

The execution of today's Air Force's "Kill Chain" is a lengthy process that is subdivided into seven "events", namely: 1) anticipate, 2) find, 3) fix, 4) track, 5) target, 6) engage, and 7) assess. The goal of the "Kill Chain" process is to achieve single-digit sensor-to-shooter (i.e. find to engage) accomplishment against a high value target at the right time, anywhere. The current AF2T2EA "Kill Chain", implies a lengthly process since it is essentially a series of sequential processes. Currently, a minimal collaborative group of users/systems must rapidly exchange information in pursuit of shared goals, interests, missions, or processes and therefore must have a shared vocabulary for the information exchanged. This is an ambitious endeavour to accomplish in "single-digit" minutes.

---

[2] Alberts, David S., "NATO SAS-050: Exploring New Command and Control Concepts and Capabilities," Final Report presented to NATO SAS Panel, November 2005.
[3] Final Report, SAS-050, March 2006
[4] Alberts, David S., "NATO SAS-050: Exploring New Command and Control Concepts and Capabilities," Final Report presented to NATO SAS Panel, November 2005.
[5] Concept Model Overview, SAS-050 Berlin Workshop, 3 March 2004.

A sub-set of the desired attributes to effectively accomplish the "Kill Chain" process can be summarized as follows[6]:

- Focused, persistent C2ISR for all target categories, to achieve desired effects, such as: adversary's intent
- C2 of ISR assets to persistently track target entities to predict the adversary's courses of action in the battlespace
- Full-spectrum, networked ISR focused by anticipation in order to re-detect potential targets quickly, cross-cue assets to precisely geo-locate targets, and trigger the F2T2EA execution cycle
- C2 of ISR to cross-cue assets to precisely geo-locate targets
- Networked, multi-sensor inputs to characterize a target's operational, physical, functional capabilities, and tactical employment patterns
- Share information across entire operational network (i.e., collaboration)
- C2 of ISR assets to persistently track target entities to lead to other target entities
- Dynamic C2ISR network to enable target engagement at time and place of choosing
- NRT automated C2 of forces to provide consistent ROE and with human-in-the-loop
- Automated, machine-to-machine dialogue passing precise decision quality data/information across network to coalition assets
- NRT and dynamic C2 of ISR assets and collection planning and tasking to execute battle damage assessment of operational effects
- Deliver information in NRT across network of sensors, decision makers, and strikers to shorten AF2T2EA cycle

Approach

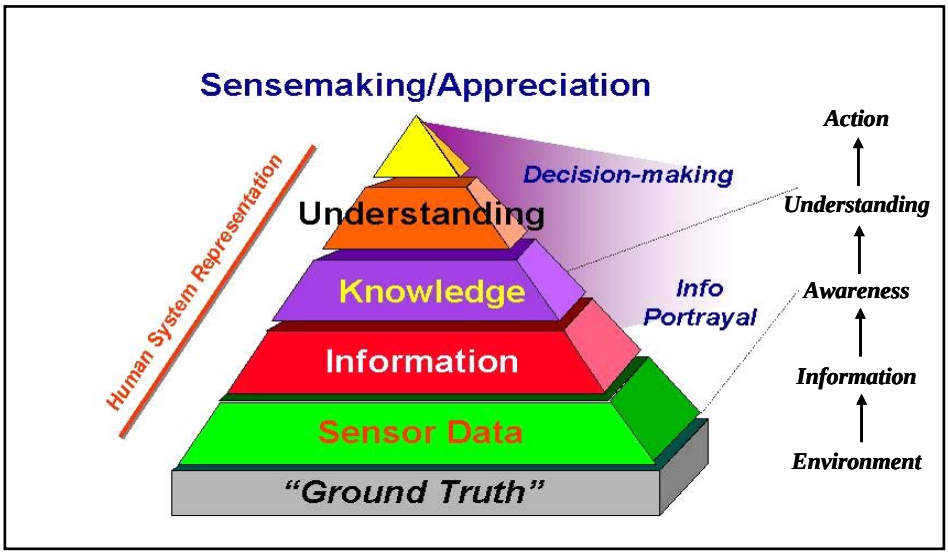


Figure 3: The "Cognitive Pyramid"

Using the cognitive pyramid approach as shown in Figure 3, the C2 Conceptual Models variables were applied to each of the seven events of the "Kill Chain" with the end-goal of assessing their completeness and/or detecting any major discrepancies.

The C2 Conceptual Model's "event view" can be thought of as the accumulation of the seven "events" that make up the AF2T2EA "Kill Chain", namely: anticipate, find, fix, track, target, engage, and assess. Overall, the AF2T2EA "Kill Chain" can be thought of as a "process", which is the second view of the C2 Conceptual Model. The third view, or "value view" can be thought of as those variables within the C2 Conceptual Model that provide "value" to particular measures of performance or effectiveness. For this illustrative example, the performance or effective measures were those variables that had a high/medium/low correlation to the seven "events" of the "Kill Chain".

[6] Capability statements taken from a 2004 HQ USAF briefing on the same subject.

Using Figure 3 as a template, the concept would be the AF2T2EA "Kill Chain"; the composite variables would be the five groupings (environment, information, awareness, understanding and action or decision); and lastly, the variables would be the list of 233 variables contained within the C2 Conceptual Model as of May 2005.

Utilizing only a sub-set of all the capabilities required to successfully prosecute the AF2T2EA process, the following capabilities were selected for further analysis:

a. Anticipate**:**
- Ability to model, predict and display possible effects and threats
- Anticipate adversary's actions in order to streamline and shorten AF2T2EA cycle
- Ability to model and predict CBRNE and TIM threats and events
- Predict how (Red, Blue, Gray) actions will cascade into direct/indirect effects in support EBO
- Requires correct, current, consistent and shared information

b. Find:
- Fully merge and integrate sensor/information to support battlespace SA
- Accurate/real-time battlespace SA, enabling decision makers to correctly react to changes
- Rapidly and accurately update situational understanding as a result of changes in SA awareness

c. Fix:
- Accurate and timely positive combat identification of surface, air, and space objects

d. Track:
- Integration/display and availability of operations information in a common operational picture
- Improve, automate, and streamline monitoring of friendly surface, air and space force location

e. Target:
- Improve Commander's COA selection and dissemination process

f. Engage:
- Better optimized use of the battlespace environment
- Conduct real-time effects-based mission execution
- Real-time collaboration among all C2 entities
- Capability to achieve self-synchronization of forces

g. Assess:
- Real-time Red, Blue Gray force status assessment
- Rapid assessment and selection of targets to maximize desired effects
- Ability to accurately assess surface/air/space impacts of physical environmental conditions
- Improve COA evaluation and requirements process

Test Cases

This illustrative example was subdivided into two test cases.

1. Test Case 1: "Process View"

For each of the seven "events" contained within the AF2T2EA "Kill Chain", the Conceptual Model's variables (233 in May 2005) were mapped into: a) environment, b) information, c) awareness, d) understanding and decision (or action) corresponding to the cognitive pyramid shown in Figure 3. The goal was to determine whether or not there were obvious variables missing from the C2 Conceptual Model.

2. Test Case 2: "Value View"

The Conceptual Model's variables were mapped into each of the capabilities listed under the AF2T2EA process. For each of the capabilities listed above, the Conceptual Model variables were evaluated as to having high, medium or low correlation to the stated AF2T2EA capabilities. The goal was to determine whether or not there were obvious discrepancies contained within the C2 Conceptual Model.

Results

The results were presented at a peer-to-peer workshop held in Virginia Beach, VA., 2-6 Oct 2005.[7]

1) Test Case 1: "Process View"

Figure 4 illustrates an example of the mapping of the C2 Conceptual Models 233 variables into the "Assess" event of the AF2T2EA "Kill Chain" process. A complete listing of the "variable-to-event" mapping with the corresponding correlation is contained in Appendix A, tables A-1 through A-7.

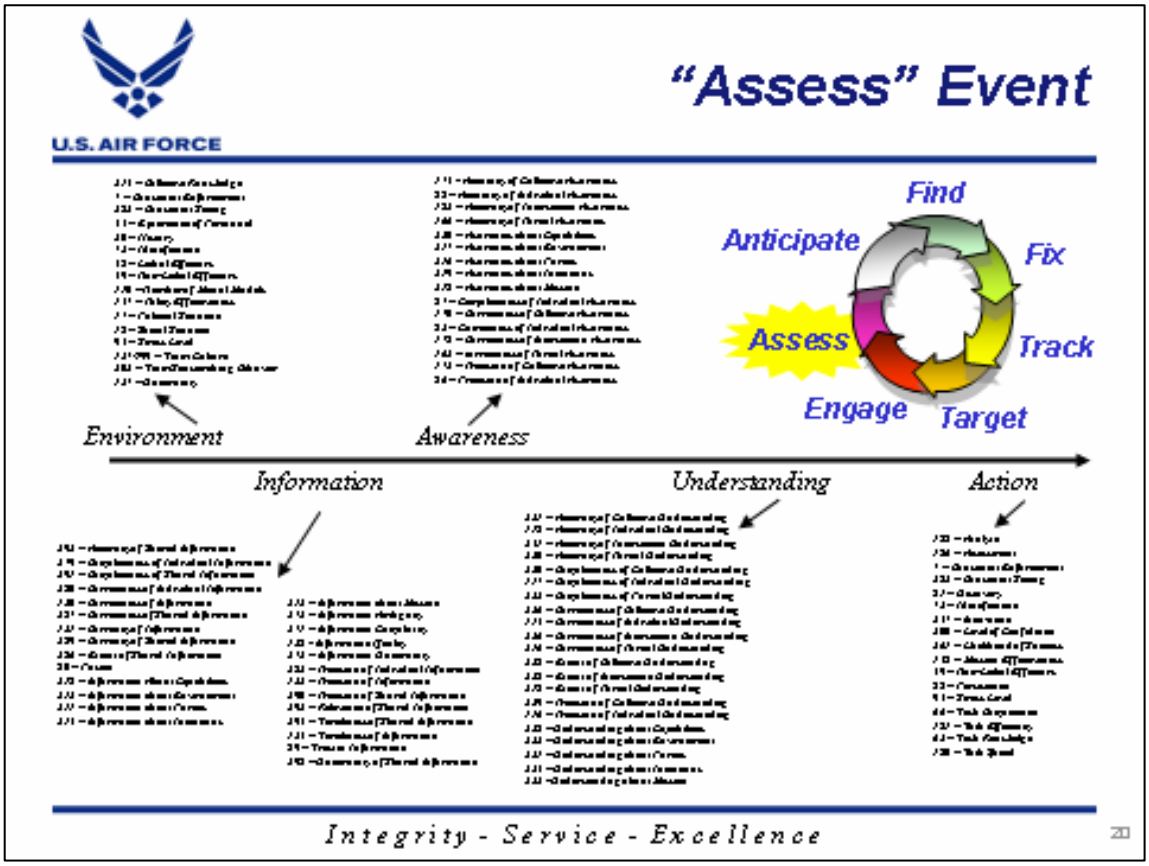


Figure 4: "Assess" Event Variable Mapping

Table 1: Number of Variables Associated with each of the AF2T2EA "Events"

"Event"	**Composite Variable**				
	Environment	Information	Awareness	Understanding	Action (or Decision)
Anticipate	6	35	16	2	19
Find	6	35	16	2	19
Fix	11	28	8	7	8
Track	15	32	19	22	34
Target	10	27	7	1	47
Engage	13	21	10	5	54
Assess	16	27	16	21	17

Table 1 illustrates the overall results of this mapping. As shown in Table 1, there is a strong correlation of the conceptual models variables to the AF2T2EA "Kill Chain" process as a whole, i.e., for each "event" within the process, the set of variables that should be dominate, are dominate. For example:

[7] Phister, Paul, "AF2T2EA – An Illustrative Example," presented at the Peer-to-Peer Workshop, 4-6 Oct 2005, Virginia Beach, VA USA.

a) *Anticipate:* Determining where a potential target could be located relies heavily on: **information** (e.g., completeness of information, currency of information, information about forces/environment/intentions, precision of information and timeliness of information); **action** (e.g., responsiveness, quality of decisions, speed of command/decision/planning, and timeliness of planning); as well as **awareness** (e.g., awareness about environment/forces/intentions/mission, history, and experience of personnel).

b) *Find:* Determining the location of a particular target relies on **information** (e.g., accuracy, completeness of information, correctness of information, currency of information, consistency of information, information quality, precision of information, timeliness of information, and trust in information); **action** (e.g., responsiveness, quality of decisions, speed of command/decision/planning, task speed, and timeliness of planning); and, **awareness** (e.g., accuracy of shared information, awareness about forces/intentions/mission, experience of personnel, and quality of interactions).

c) *Fix:* Once a target is located, determining an exact "fix" in order to apply the appropriate weapon relies on **information** (e.g., accuracy, authentication, currency, identification, information ambiguity/complexity/quality, precision, and timeliness); the **environment** (e.g., network availability/reach/reliability, sensor coverage and persistence), and, **awareness** (accuracy, adaptiveness, level of confidence, and task competence).

d) *Track:* Once a target is found, the ability to continuously track relies on **action** (e.g., adaptiveness, collaboration about environment/forces/intentions/mission, flexibility, innovation, responsiveness, robustness, and speed of command/planning); **information** (e.g., accuracy, completeness, consistency, fusion, information about environment/forces/intentions, precision of information, and timeliness of individual/shared information), and **understanding** (accuracy, completeness, consistency, correctness, currency and timeliness).

e) *Target:* Once the target is "fixed" the ability to target with a weapon relies on **action** (e.g., accuracy, authentication, constraint enforcement, experience of personnel, lethal and non-lethal effectors, and skill), **information** (e.g., completeness, consistency, correctness, currency, information about environment/forces/mission, precision, timeliness and trust in the information) and the **environment** (atmospheric/space weather, political/social situation, sensor coverage and persistence).

f) *Engage:* To actually "engage" the target with the appropriate weapon relies on **action** (e.g., accuracy, dynamics across time, lethal and non-lethal effectors, risk propensity, task efficiency, willingness, adaptiveness, trust, speed of command, skill, and criticality); **information** (completeness, correctness, currency, precision, relevance, timeliness, and trust); and, the **environment** (atmospheric weather, network availability/reach/reliability, and the political/social situation).

g) *Assess:* After the target has been engaged, to adequately assess the "effect" relies on **information** (e.g., accuracy, completeness, correctness, fusion, information ambiguity/complexity/quality/uncertainty, precision, timeliness, and relevance); **understanding** (accuracy, completeness, correctness, precision, and the understanding about capabilities/environment/forces/intentions/mission); and **awareness** (accuracy, correctness, precision, completeness, and the awareness about forces/missions/capabilities/environment).

2) Test Case 2: “Value View”

Figure 5 illustrates an example of the mapping of the C2 Conceptual Models 233 variables into the capabilities associated with the “Assess” event of the AF2T2EA “Kill Chain” process. For each of the variables, an assessment was performed as to its’ high (red)/med (blue)/low (black) correction to the capability as shown in Figure 5. A complete listing of the “variable-to-capability” mapping for each AF2T2EA “even” with the corresponding correlation is contained in Appendix B, tables B-1 through B-7.

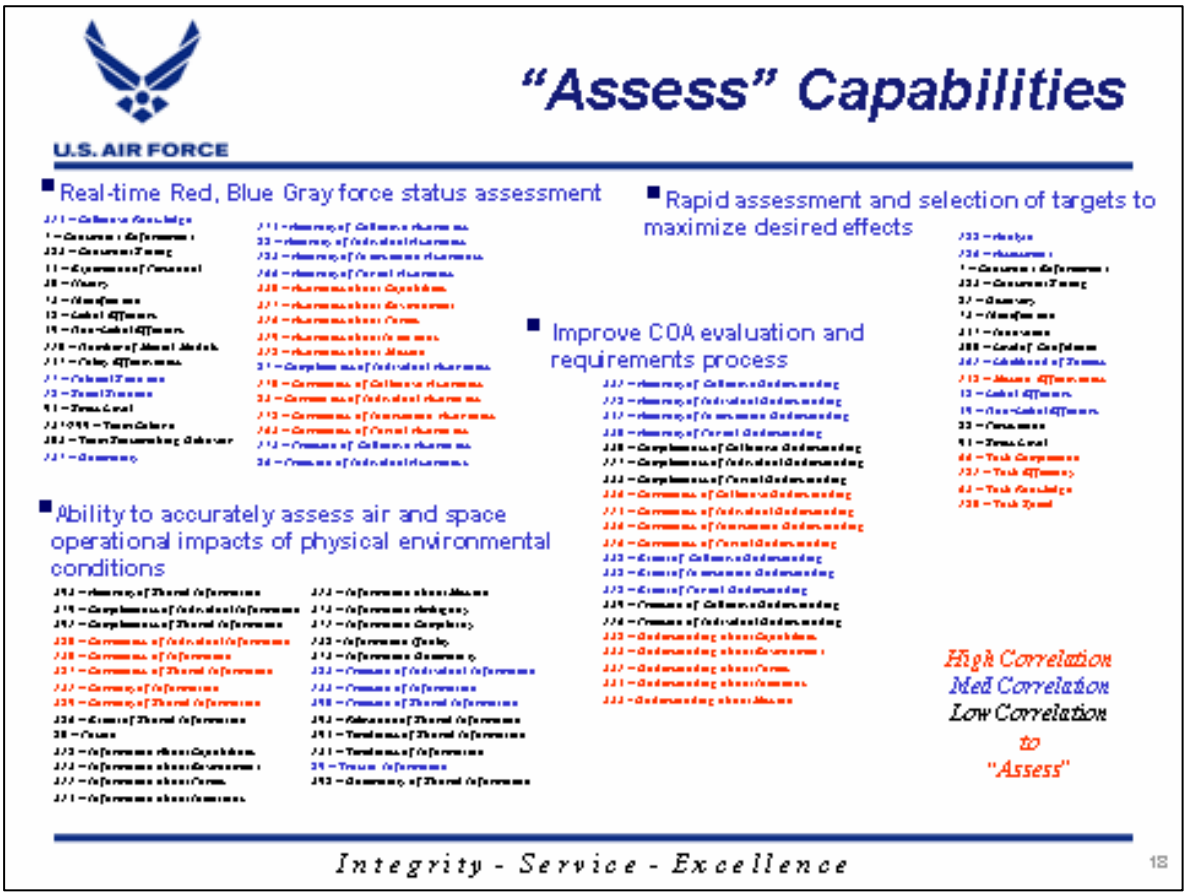


Figure 5: “Assess” Event Value Mapping

Table 2 illustrates the resultant mapping of variables to capabilities for the AF2T2EA “Kill Chain”. A complete listing of the “variable-to-capability” mapping with the corresponding correlation is contained in Appendix C, Table C-1.

Table 2: Variable Mapping to “Event” Capabilities

“Event”	Number of Variables Mapped (not unique)	Number of Capabilities contained within “Event”	Correlations		
			High	Medium	Low
Anticipate	88	4	18	16	54
Find	79	3	18	12	49
Fix	53	1	15	8	30
Track	121	2	28	20	73
Target	88	1	14	26	48
Engage	107	4	14	35	58
Assess	98	4	28	27	43

Table 3 provides a top level summary of the information contained in Appendix C.

Table 3: Value View of the AF2T2EA "Kill Chain"

"Event"	Variable (1)	Variable (2)	Variable (3)	Variable (4)	Variable (5)
Anticipate	Understanding	Uncertainty	Information	Awareness	Correctness
Find	Sensor	Correctness	Timeliness	Awareness	Speed
Fix	Correctness	Precision	Timeliness	Accuracy	Level of Confidence
Track	Correctness	Accuracy	Understanding	Sensor	Timeliness
Target	Accuracy	Currency	Lethal and Non-Lethal Effectors	Situation	Awareness
Engage	Awareness	Speed	Task	Mission Effectiveness	Lethal and Non-lethal Effectors
Assess	Understanding	Awareness	Correctness	Task	Mission Effectiveness

As illustrated in the table above, the following information can be extracted:

a) Anticipate: An understanding of the environment and an adversary's intentions are paramount if you want to "predict" their next move or determine the most likely location of a potential target. Information and Awareness about forces, the environment, and mission provide much needed information to the decision maker.

b) Find: Persistent ISR is a must in order to locate targets under a wide range of conditions. Speed of command, speed of decisions, speed of planning, and speed of performing the required tasks play a dominate role in the ability of "finding" potential targets.

c) Fix: Accuracy is a term that has multiple dimensions within the context of the C2 Conceptual Model. The term includes the accuracy of: individual awareness; individual understanding; and, collective understanding. All of these need to come together in a coherent form in order to provide a continuous "fix" on targets.

d) Track: Correctness is a term that has multiple dimensions. In the context of the C2 Conceptual Model, this term includes the correctness of: individual information; shared information; individual awareness; collective awareness; partial awareness; individual understanding; partial understanding; and, collective understanding. These are complex entities that must be used collectively in order to determine the exact location of potential targets.

e) Target: Currency is a term that has multiple dimensions within the C2 Conceptual Model. This term includes the currency of: information; individual information; and shared information. These entities are important ingredients if a potential target is to be successfully engaged.

f) Engage: Awareness contains the following elements: capabilities; forces; the environment; adversary's intentions; and the mission. These variables need to successfully come together to successfully engage in a target located anywhere at anytime.

g) Assess: Correctness is a term that has a significant amount of dimensions within the C2 Concept Model. This term includes the correctness of: information, individual information, shared information, individual awareness, collective awareness, partial awareness, intersection awareness, individual understanding, collective understanding, partial understanding, intersection understanding; the assigned task: competence to perform the assigned task, efficiency of performing the assigned task, knowledge, and speed of execution.

Summary

As a result of the NATO panel (SAS-050), the first-ever version of a Command and Control Conceptual Model has been developed. The intent of this model is to support the exploration of new, networked-enabled approaches to C2 and compare their characteristics, performance, effectiveness, and agility to traditional approaches to C2. As an illustrative example, the application of the C2 Conceptual Model was applied to each of the seven areas of the AF2T2EA "Kill Chain" process in two test cases. Test case one mapped the model's variables (233) into each of the AF2T2EA events via five bins (environment, information, awareness, understanding and decision). The result represented the Conceptual Model's "process view". The results of test case one provided some insight into the C2 Conceptual Models ability to map into the AF2T2EA "Kill Chain". Test case one did not uncover major shortcomings of the C2 Conceptual Model. Test case two mapped (high, medium, low) the model's variables into a set of AF2T2EA required capabilities. The result represented the Conceptual Model's "value view". Test case two did not uncover any major discrepancies of the C2 Conceptual Model. This illustrative example, demonstrated the viability of two of the C2 Conceptual Model's primary goals, namely: a conceptual model that contained key variables and the relationships and conducting a test case to demonstrate the Model's utility. In both test cases, the C2 Conceptual Model was shown to be "viable" and contain no major shortcomings or discrepancies.

Bibliography

Paul W. Phister, Jr., Ph.D., P.E.
Paul Phister is the Senior Air & Space Strategic Planner at the Air Force Research Laboratory's *Information Directorate* headquartered in Rome, New York. Dr. Phister is considered both a space and C2 expert and holds two masters degrees and received his Ph.D. in Engineering from California Coast University. Dr. Phister is a licensed Professional Software Engineer from the State of Texas and a senior member of the IEEE.

APPENDIX A

Mapping Conceptual Model variables to the AF2T2EA "Kill-Chain" Process.

Cognitive Pyramid	Conceptual Model Variable	
Environment	***Atmospheric Weather***	***Sensor Coverage (Spacial)***
	Space Weather	***Sensor Coverage (Medium)***
	Sensor Persistence	***Sensor Coverage (Spectrum)***
Information	***Accuracy***	***Information about Forces***
	Completeness of Information	***Information about Environment***
	Completeness of Individual Information	***Information about intentions***
	Completeness of Shared Information	***Information Uncertainty***
	Correctness of Information	***Network Reach***
	Correctness of Individual Information	***Precision of Information***
	Correctness of Shared Information	***Precision of Individual Information***
	Currency of Information	***Precision of Shared Information***
	Currency of Individual Information	***Relevance of Shared Information***
	Currency of Shared Information	***Richness of Collaborative Environment***
	Consistency of Information	***Share Information***
	Consistency of Individual Information	***Timeliness of Information***
	Consistency of Shared Information	***Timeliness of Individual Information***
	Data Interoperability	***Timeliness of Shared Information***
	Distribution of Information	***Trust in Information***
	Extent of Shared Information	***Uncertainty***
	Fusion	***Uncertainty of Shared Information***
	Information Quality	
Awareness	***Accuracy of Individual Awareness***	***Collaboration about Intentions***
	Accuracy of Shared Information	***Command Approach***
	Awareness about Environment	***Experience of Personnel***
	Awareness about Forces	***Frequency of Command Interactions***
	Awareness about Intentions	***Frequency of Peer-to-Peer Interactions***
	Awareness about Mission	***History***
	Collaboration about Environment	***Quality of Interactions***
	Collaboration about Forces	***Quality of Peer-to-Peer Interactions***
Understanding	***Understanding about Environment***	***Understanding about Intentions***
Decision or Action	***Accuracy of Individual Decisions***	***Relevance of Individual Decisions***
	Consistency of Individual Decisions	***Speed of Command***
	Completeness of Individual Decisions	***Speed of Decision***
	Correctness of Individual Decisions	***Speed of Planning***
	Currency of Individual Decisions	***Synchronization of Actions***
	Force Effectiveness	***Task Speed***
	Mode of Decision Making of Individual Decisions	***Timeliness of Planning***
	Responsiveness	***Timeliness of Individual Decisions***
	Precision of Individual Decisions	***Uncertainty of Individual Decisions***
	Quality of Decisions	

Table A-1: "Anticipate" Event

Cognitive Pyramid	Conceptual Model Variable	
Environment	***Atmospheric Weather***	***Sensor Coverage (Spacial)***
	Space Weather	***Sensor Coverage (Medium)***
	Sensor Persistence	***Sensor Coverage (Spectrum)***
Information	***Accuracy***	***Information about Forces***
	Completeness of Information	***Information about Environment***
	Completeness of Individual Information	***Information about intentions***
	Completeness of Shared Information	***Information Uncertainty***
	Consistency of Information	***Network Reach***
	Consistency of Individual Information	***Precision of Information***
	Consistency of Shared Information	***Precision of Individual Information***
	Correctness of Information	***Precision of Shared Information***
	Correctness of Individual Information	
	Correctness of Shared Information	***Relevance of Shared Information***
	Currency of Information	***Richness of Collaborative Environment***
	Currency of Individual Information	***Share Information***
	Currency of Shared Information	***Timeliness of Information***
	Data Interoperability	***Timeliness of Individual Information***
	Distribution of Information	***Timeliness of Shared Information***
	Extent of Shared Information	***Trust in Information***
	Fusion	***Uncertainty***
	Information Quality	***Uncertainty of Shared Information***
Awareness	***Accuracy of Individual Awareness***	***Collaboration about Intentions***
	Accuracy of Shared Information	***Command Approach***
	Awareness about Environment	***Experience of Personnel***
	Awareness about Forces	***Frequency of Command Interactions***
	Awareness about Intentions	***Frequency of Peer-to-Peer Interactions***
	Awareness about Mission	***History***
	Collaboration about Environment	***Quality of Interactions***
	Collaboration about Forces	***Quality of Peer-to-Peer Interactions***
Understanding	***Understanding about Environment***	***Understanding about Intentions***
Decision or Action	***Accuracy of Individual Decisions***	***Speed of Decision***
	Consistency of Individual Decisions	***Force Effectiveness***
	Completeness of Individual Decisions	***Mode of Decision Making of Individual Decisions***
	Correctness of Individual Decisions	***Responsiveness***
	Currency of Individual Decisions	***Precision of Individual Decisions***
	Quality of Decisions	***Task Speed***
	Relevance of Individual Decisions	***Timeliness of Planning***
	Speed of Planning	***Timeliness of Individual Decisions***
	Synchronization of Actions	***Uncertainty of Individual Decisions***
	Speed of Command	

Table A-2: "Find" Event

Cognitive Pyramid	Conceptual Model Variable	
Environment	***Analyze***	***Quality of Computing Equipment***
	Network Availability	***Sensor Coverage (Spacial)***
	Network Reach	***Sensor Coverage (Medium)***
	Network Reliability	***Sensor Coverage (Spectrum)***
	Quality of Communications Equipment	***Sensor Persistence***
Information	***Accuracy***	***Information Ambiguity***
	Authentication	***Information Complexity***
	Completeness of Information	***Information Quality***
	Consistency of Information	***Information Uncertainty***
	Consistency of Shared Information	***Precision of Individual Information***
	Correctness of Information	***Precision of Information***
	Correctness of Shared Information	***Precision of Shared Information***
	Currency of Shared Information	***Relevance of Shared Information***
	Distribution of Information	***Share Information***
	Extend of Shared Information	***Timeliness of Shared Information***
	Fusion	***Timeliness of Individual Information***
	Identification	***Timeliness of Information***
	Information About Capabilities	***Uncertainty of Shared Information***
Awareness	***Accuracy of Individual Awareness***	***Identification***
	Adaptiveness	***Level of Confidence***
	Awareness about Capabilities	***Task Competence***
	Awareness about Intentions	
Understanding	***Accuracy of Collective understanding***	***Completeness of Collective Understanding***
	Accuracy of Individual Understanding	***Identification***
	Collective Knowledge	***Level of Confidence***
Decision or Action	***Command Approach***	***Mission Effectiveness***
	Completeness of Individual Decisions	***Task Competence***
	Identification	***Task Speed***
	Level of Confidence	

Table A-3: "Fix" Event

Cognitive Pyramid	Conceptual Model Variable	
Environment	***Accuracy***	***Network Reach***
	Adaptiveness	***Responsiveness***
	Analyze	***Robustness***
	Atmospheric Weather	***Sensor Coverage (Medium)***
	Dynamics across Time	***Sensor coverage (Spacial)***
	History	***Sensor Coverage (Spectrum)***
	Indirect Sensing	***Space Weather***
	Mobility	
Information	***Accuracy***	***Flexibility***
	Accuracy of Shared Information	***Fusion***
	Completeness of Individual Information	***Information about Environment***
	Completeness of Information	***Information about Forces***
	Completeness of Shared Information	***Information about Intentions***
	Consistency of Individual Information	***Information Quality***
	Consistency of Information	***Information Uncertainty***
	Consistency of Shared Information	***Precision of Individual Information***
	Currency of Shared Information	***Precision of Information***
	Currency of Individual Information	***Precision of Shared Information***
	Currency of Information	***Relevance o f Shared Information***
	Correctness of Individual Information	***Shared Understanding***
	Correctness of Shared Information	***Timeliness of Shared Information***
	Distribution of Information	***Timeliness of Individual Information***
	Dynamics across Time	***Timeliness of Information***
	Extend of Shared Information	***Uncertainty of Shared Information***
Awareness	***Accuracy of collective Awareness***	***Correctness of Collective Awareness***
	Accuracy of Individual Awareness	***Correctness of Individual Awareness***
	Accuracy of Intersection Awareness	***Correctness of Partial Awareness***
	Accuracy of Partial Awareness	***Currency of Collective Awareness***
	Awareness about Environment	***Currency of Individual Awareness***
	Awareness about Forces	***Precision of Individual Awareness***
	Awareness about Intentions	***Timeliness of Collective Awareness***
	Awareness about Mission	***Timeliness of Individual Awareness***
	Completeness of Individual Awareness	***Uncertainty of Collective Awareness***
	Consistency of Individual Awareness	
Understanding	***Accuracy of Collective Understanding***	***Correctness of Collective Understanding***
	Accuracy of Individual Understanding	***Correctness of Individual Understanding***
	Accuracy o f Intersection Understanding	***Correctness of Partial Understanding***
	Accuracy of Partial Understanding	***Currency of Collective Understanding***
	Completeness of Collective Understanding	***Currency of Individual Understanding***
	Completeness of Individual Understanding	***Extent of collective Understanding***
	Completeness of Intersection Understanding	***Extent of Partial Understanding***
	Completeness of Partial Understanding	***Shared Understanding***
	Consistency of Individual Understanding	***Timeliness of Collective Understanding***
	Consistency of Intersection Understanding	***Timeliness o f Individual Understanding***
	Consistency of Partial Understanding	***Uncertainty of Collective Understanding***
Decision or Action	***Adaptiveness***	***Responsiveness***
	Analyze	***Risk Propensity***
	Collaboration about Environment	***Robustness***
	Collaboration about Forces	***Speed of Command***
	Collaboration about Intentions	***Speed of Decision***
	Collaboration about Mission	***Speed of Planning***
	Command Approach	***Synchronization of Decisions***
	Distribution of Information	***Synchronization of Actions***
	Dynamics across Time	***Task Competency***
	Experience of Personnel	***Task Speed***
	Flexibility	***Timeliness of Individual Decisions***
	History	***Training***
	Innovation	***Trust in Information***
	Level of Confidence	***Understanding about Environment***
	Perception of Cause and Effect	***Understanding about Forces***
	Quality of Decisions	***Understanding about Intentions***
	Quality of Plan	***Understanding about Mission***

Table A-4: "Track" Event

Cognitive Pyramid	Conceptual Model Variable	
Environment	***Atmospheric Weather***	***Sensor Coverage (Spacial)***
	Direct Sensing	***Sensor Coverage (Spectrum)***
	Indirect Sensing	***Sensor Persistence***
	Political Situation	***Social Situation***
	Sensor Coverage (Medium)	***Space Weather***
Information	***Completeness of Information***	***Information about Mission***
	Completeness of Shared Information	***Information Quality***
	Consistency of Information	***Information Uncertainty***
	Consistency of Shared Information	***Precision of Individual Information***
	Correctness of Individual Information	***Precision of Information***
	Correctness of Shared Information	***Precision of Shared Information***
	Currency of Individual Information	***Relevance of Shared Information***
	Currency of Information	***Share Information***
	Currency of Shared Information	***Timeliness of Shared Information***
	Data Interoperability	***Timeliness of Individual Information***
	Distribution of Information	***Timeliness of Information***
	Extent of Shared Information	***Trust in Information***
	Information about Environment	***Uncertainty of Shared Information***
	Information about Forces	
Awareness	***Accuracy of Collective Awareness***	***Awareness about Forces***
	Accuracy of Intersection Awareness	***Awareness about Intentions***
	Awareness about Capabilities	***Awareness about Mission***
	Awareness about Environment	
Understanding	***Quality of Understanding***	
Decision or Action	***Accuracy of Individual Decisions***	***Political Situation***
	Appropriateness o f Individual Decisions	***Quality of Decisions***
	Authentication	***Quality of Plan***
	C2 Doctrine	***Resource Allocation***
	Command Approach	***Resource Prioritization***
	Communication of Intent	***Responsiveness***
	Constraint Enforcement	***Risk Propensity***
	Constraint Setting	***Robustness***
	Control Approach	***Role of Authority***
	Criticality	***Skill***
	Decision Participants	***Task Speed***
	Degree of Decision Concurrence	***Social Situation***
	Dynamics across time	***Speed of Command***
	Experience of Personnel	***Synchronization***
	Flexibility	***Synchronization of Actions***
	Force Effectiveness	***Task Competence***
	Identification	***Task Efficiency***
	Indirect Sensing	***Task Knowledge***
	Individual Task Efficiency	***Timeliness of Individual Decisions***
	Lethal Effectors	***Training***
	Likelihood of Success	***Trust in Information***
	Mission Effectiveness	***Uncertainty of Individual Decisions***
	Nature of Rules	***Willingness***
	Non-Lethal Effectors	

Table A-5: "Target" Event

Cognitive Pyramid	Conceptual Model Variable	
Environment	***Atmospheric Weather***	***Network Reliability***
	Communications Interoperability	***Network Richness***
	Complicated-ness	***Political situation***
	Data Interoperability	***Quality of communications Equipment***
	Electivity	***Quality of Computing Equipment***
	Network Availability	***Social Situation***
	Network Reach	
Information	***Completeness of Individual Information***	***Information about Intentions***
	Completeness of Shared Information	***Information about Mission***
	Correctness of Information	***Information Quality***
	Correctness of Shared Information	***Precision of Individual Information***
	Currency of Individual Information	***Precision of Information***
	Currency of Information	***Relevance of shared Information***
	Currency of Shared Information	***Timeliness of Shared Information***
	Distribution of Information	***Timeliness of Information***
	Extent of Shared Information	***Trust in Information***
	Information about Environment	***Uncertainty of Shared Information***
	Information about Forces	
Awareness	***Awareness about Capabilities***	***Completeness of Individual Awareness***
	Awareness about Environment	***Correctness of Collective Awareness***
	Awareness about Forces	***Currency of Collective Awareness***
	Awareness about Intentions	***Currency of Individual Awareness***
	Awareness about Mission	***Shared Awareness (intersection)***
Understanding	***Completeness of Collective Understanding***	***Quality of Understanding***
	Correctness of Collective Understanding	***Uncertainty of Individual Understanding***
	Currency of Collective Understanding	
Decision or Action	***Accuracy***	***Resource Prioritization***
	Adaptiveness	***Responsiveness***
	Authentication	***Role of Authority***
	C2 Doctrine	***Risk Propensity***
	Clarity about role	***Robustness***
	Command Approach	***Role of Emotion***
	Command Arrangements	***Selectivity***
	Communication of Intent	***Skill***
	Constraint Enforcement	***Sleep Deprivation***
	Constraint Setting	***Social Situation***
	Control Approach	***Speed of Command***
	Criticality	***Speed of Decision***
	Dynamics across Time	***State of Mental Health***
	Experience of Personnel	***State of Physical Health***
	Extent of Shared Information	***Stress Level***
	Force Will	***Synchronization***
	Identification	***Synchronization of Actions***
	Leadership	***Task Competence***
	Lethal effectors	***Task Efficiency***
	Level of Confidence	***Task Knowledge***
	Likelihood of Success	***Task Speed***
	Mission Effectiveness	***Team Culture***
	Mobility	***Team Decisions***
	Nature of Rules	***Training***
	Non-Lethal Effectors	***Trust in Information***
	Perception of Cause and Effect	***Trust in People***
	Political situation	***Willingness***
	Resource Allocation	

Table A-6: "Engage" Event

Cognitive Pyramid	Conceptual Model Variable	
Environment	***Collective Knowledge***	***Number of Mental Models***
	Constraint Enforcement	***Policy Effectiveness***
	Constraint Setting	***Political Situation***
	Experience of Personnel	***Social Situation***
	History	***Stress Level***
	Identification	***Team Culture***
	Lethal Effectors	***Team Sensemaking Behavior***
	Non-Lethal Effectors	***Uncertainty***
Information	***Accuracy of Shared Information***	***Information about Mission***
	Completeness of Individual Information	***Information Ambiguity***
	Completeness of Shared Information	***Information Complexity***
	Correctness of Individual Information	***Information Quality***
	Correctness of Information	***Information Uncertainty***
	Correctness of Shared Information	***Precision of Individual Information***
	Currency of Information	***Precision of Information***
	Currency of Shared Information	***Precision of Shared Information***
	Extent of Shared Information	***Relevance of Shared Information***
	Fusion	***Timeliness of Shared Information***
	Information About Capabilities	***Timeliness of Information***
	Information about Environment	***Trust in Information***
	Information about Forces	***Uncertainty of Shared Information***
	Information about Intentions	
Awareness	***Accuracy of Collective Awareness***	***Awareness about Mission***
	Accuracy of Individual Awareness	***Completeness of Individual Awareness***
	Accuracy of Intersection Awareness	***Correctness of Collective Awareness***
	Accuracy of Partial Awareness	***Correctness of Individual Awareness***
	Awareness about Capabilities	***Correctness of Intersection Awareness***
	Awareness about Environment	***Correctness of Partial Awareness***
	Awareness about Forces	***Precision of Collective Awareness***
	Awareness about Intentions	***Precision of Individual Awareness***
Understanding	***Accuracy of Collective Understanding***	***Extent of Collective Understanding***
	Accuracy of Individual Understanding	***Extent of Intersection Understanding***
	Accuracy of Intersection Understanding	***Extent of Partial Understanding***
	Accuracy of Partial Understanding	***Precision of Collective Understanding***
	Completeness of Collective Understanding	***Precision of Individual Understanding***
	Completeness of Individual Understanding	***Understanding about Capabilities***
	Completeness of Partial Understanding	***Understanding about Environment***
	Correctness of Collective Understanding	***Understanding about Forces***
	Correctness of Individual Understanding	***Understanding about Intentions***
	Correctness of Intersection Understanding	***Understanding about Mission***
	Correctness of Partial Understanding	
Decision or Action	***Analyze***	***Mission Effectiveness***
	Assessment	***Non-Lethal Effectors***
	Constraint Enforcement	***Persistence***
	Constraint Setting	***Stress Level***
	Discovery	***Task Competence***
	Identification	***Task Efficiency***
	Innovation	***Task Knowledge***
	Level of Confidence	***Task Speed***
	Likelihood of Success	

Table A-7: "Assess" Event

APPENDIX B

Determining the value of the Conceptual Model Variables within the AF2T2EA "Kill-Chain" process. Each of the conceptual model variables were assigned a "value" as to contributing towards the stated capability for each of the seven events within the AF2T2EA "Kill Chain" process.

"Anticipate" Event		
High Value	**Medium Value**	**Low Value**
Ability to model, predict and display possible effects, warn, and report CBRNE and TIM threats		
Understanding about Intentions		Atmospheric Weather
Understanding about Environment		Space Weather
		Sensor Persistence
		Sensor Coverage (Spacial)
		Sensor Coverage (Medium)
		Sensor Coverage (Spectrum)
Predict how actions (Red, Blue, Gray) will cascade into direct and indirect effects in support of effects-based operations		
Correctness of Information	Completeness of Individual Information	Accuracy
Correctness of Individual Information	Completeness of Shared Information	Completeness of Information
Correctness of Shared Information	Precision of Information	Currency of Information
Information about Forces	Precision of Individual Information	Currency of Individual Information
Information about Environment	Precision of Shared Information	Currency of Shared Information
Information about intentions	Relevance of Shared Information	Consistency of Information
Information Uncertainty	Timeliness of Information	Consistency of Individual Information
Uncertainty	Timeliness of Individual Information	Consistency of Shared Information
	Timeliness of Shared Information	Distribution of Information
	Uncertainty of Shared Information	Data Interoperability
		Extent of Shared Information
		Fusion
		Information Quality
		Network Reach
		Richness of Collaborative Environment
		Share Information
		Trust in Information
Anticipate adversary's action(s) in order to streamline and shorten Find, Fix, Track, Target, Engage, and Assess (F2T2EA) cycle		
Awareness about Environment	Task Speed	Accuracy of Individual Awareness
Awareness about Forces	Timeliness of Planning	Accuracy of Individual Decisions
Awareness about Intentions	Force Effectiveness	Accuracy of Shared Information
Awareness about Mission	Speed of Command	Collaboration about Environment
	Speed of Decision	Collaboration about Forces
	Speed of Planning	Collaboration about Intentions
		Command Approach
		Completeness of Individual Decisions
		Consistency of Individual Decisions
		Correctness of Individual Decisions
		Currency of Individual Decisions
		Experience of Personnel
		Frequency of Command Interactions
		Frequency of Peer-to-Peer Interactions
		History
		Mode of Decision Making of Individual Decisions
		Precision of Individual Decisions
		Quality of Decisions
		Quality of Interactions
		Quality of Peer-to-Peer Interactions
		Relevance of Individual Decisions
		Responsiveness
		Synchronization of Actions
		Timeliness of Individual Decisions
		Uncertainty of Individual Decisions
Ability to model and predict CBRNE and TIM threats and events		
Understanding about Intentions		Atmospheric Weather
Understanding about Environment		Space Weather
		Sensor Persistence
		Sensor Coverage (Spacial)
		Sensor Coverage (Medium)
		Sensor Coverage (Spectrum)

Table B-1: "Anticipate" Value

"Find" Event		
High Value	**Medium Value**	**Low Value**
Fully merge and integrate sensor information to support battlespace situational awareness		
Sensor Coverage (Spacial)		***Atmospheric Weather***
Sensor Coverage (Medium)		***Collaboration about Environment***
Sensor Coverage (Spectrum)		***Command Approach***
Sensor Persistence		***Frequency of Command Interactions***
		Frequency of Peer-to-Peer Interactions
		History
		Quality of Interactions
		Quality of Peer-to-Peer Interactions
		Space Weather
Rapidly and accurately updated situational understanding as a result of changes in situational awareness		
Correctness of Information	Currency of Information	Accuracy
Correctness of Individual Information	Currency of Individual Information	Completeness of Information
Correctness of Shared Information	Currency of Shared Information	Completeness of Individual Information
Timeliness of Information	Precision of Information	Completeness of Shared Information
Timeliness of Individual Information	Precision of Individual Information	Consistency of Information
Timeliness of Shared Information	Precision of Shared Information	Consistency of Individual Information
	Trust in Information	Consistency of Shared Information
		Data Interoperability
		Distribution of Information
		Experience of Personnel
		Extent of Shared Information
		Fusion
		Information Quality
		Information about Forces
		Information about Environment
		Information about intentions
		Information Uncertainty
		Network Reach
		Relevance of Shared Information
		Richness of Collaborative Environment
		Share Information
		Uncertainty
		Uncertainty of Shared Information
Accurate and real-time situational awareness of the battlespace to enable decision makers to correctly react to dynamic changes		
Awareness about Environment	***Accuracy of Individual Awareness***	***Accuracy of Individual Decisions***
Awareness about Forces	***Accuracy of Shared Information***	***Collaboration about Forces***
Awareness about Intentions	***Force Effectiveness***	***Collaboration about Intentions***
Awareness about Mission	***Responsiveness***	***Command Approach***
Speed of Command	***Synchronization of Actions***	***Completeness of Individual Decisions***
Speed of Decision		***Control Approach***
Speed of Planning		***Consistency of Individual Decisions***
Task Speed		***Correctness of Individual Decisions***
		Currency of Individual Decisions
		Experience of Personnel
		Mode of Decision Making of Individual Decisions
		Precision of Individual Decisions
		Quality of Decisions
		Relevance of Individual Decisions
		Timeliness of Planning
		Timeliness of Individual Decisions
		Uncertainty of Individual Decisions

Table B-2: "Find" Value

"Fix" Event		
High Value	**Medium Value**	**Low Value**
Accurate and timely positive combat identification of ground, air, and space objects		
Accuracy of Collective understanding	Accuracy	Analyze
Accuracy of Individual Understanding	Adaptiveness	Awareness about Capabilities
Accuracy of Individual Awareness	Authentication	Awareness about Intentions
Correctness of Information	Currency of Shared Information	Collective Knowledge
Correctness of Shared Information	Completeness of Collective Understanding	Command Approach
Precision of Individual Information	Identification	Completeness of Information
Precision of Information	Level of Confidence	Completeness of Individual Decisions
Precision of Shared Information		Consistency of Information
Sensor Coverage (Spacial)		Consistency of Shared Information
Sensor Coverage (Medium)		Distribution of Information
Sensor Coverage (Spectrum)		Extend of Shared Information
Sensor Persistence		Fusion
Timeliness of Shared Information		Identification
Timeliness of Individual Information		Information About Capabilities
Timeliness of Information		Information Ambiguity
		Information Complexity
		Information Quality
		Information Uncertainty
		Mission Effectiveness
		Network Availability
		Network Reach
		Network Reliability
		Quality of Communications Equipment
		Quality of Computing Equipment
		Relevance of Shared Information
		Share Information
		Task Competence
		Task Speed
		Uncertainty of Shared Information

Table B-3: "Fix" Value

"Track" Event		
High Value	**Medium Value**	**Low Value**
Integration and display of operations information in a common operational picture available to entire network		
Accuracy of Shared Information	Accuracy	Adaptiveness
Accuracy of collective Awareness	Completeness of Information	Atmospheric Weather
Accuracy of Individual Awareness	Completeness of Individual Information	Analyze
Accuracy of Intersection Awareness	Completeness of Shared Information	Awareness about Environment
Accuracy of Partial Awareness	Currency of Individual Information	Awareness about Forces
Accuracy of Collective Understanding	Currency of Information	Awareness about Intentions
Accuracy of Individual Understanding	Currency of Shared Information	Awareness about Mission
Accuracy o f Intersection Understanding	Information about Environment	Completeness of Collective Understanding
Accuracy of Partial Understanding	Information about Forces	Completeness of Individual Awareness
Correctness of Collective Awareness	Information about Intentions	Completeness of Individual Understanding
Correctness of Collective Understanding		Completeness of Intersection Understanding
Correctness of Individual Awareness		Completeness of Partial Understanding
Correctness of Individual Information		Consistency of Information
Correctness of Individual Understanding		Consistency of Individual Information
Correctness of Partial Awareness		Consistency of Individual Awareness
Correctness of Partial Understanding		Consistency of Individual Understanding
Correctness of Shared Information		Consistency of Intersection Understanding
Timeliness of Collective Awareness		Consistency of Partial Understanding
Timeliness of Collective Understanding		Consistency of Shared Information
Timeliness of Individual Awareness		Currency of Collective Awareness
Timeliness of Individual Information		Currency of Collective Understanding
Timeliness o f Individual Understanding		Currency of Individual Awareness
Timeliness of Information		Currency of Individual Understanding
Timeliness of Shared Information		Distribution of Information
		Dynamics across Time
		Extend of Shared Information
		Extent of collective Understanding
		Extent of Partial Understanding
		Flexibility
		Fusion
		History
		Information Quality
		Information Uncertainty
		Indirect Sensing
		Network Reach
		Precision of Individual Awareness
		Precision of Individual Information
		Precision of Information
		Precision of Shared Information
		Relevance o f Shared Information
		Responsiveness
		Robustness
		Shared Understanding
		Uncertainty of Collective Awareness
		Uncertainty of Collective Understanding
		Uncertainty of Shared Information
Improve, automate, and streamline monitoring of friendly air and space force location		
Understanding about Environment	Adaptiveness	Analyze
Understanding about Forces	Flexibility	Collaboration about Environment
Understanding about Intentions	Responsiveness	Collaboration about Forces
Understanding about Mission	Robustness	Collaboration about Intentions
	Sensor Coverage (Medium)	Collaboration about Mission
	Sensor coverage (Spacial)	Command Approach
	Sensor Coverage (Spectrum)	Distribution of Information
	Space Weather	Dynamics across Time
	Task Speed	Experience of Personnel
	Trust in Information	History
		Innovation
		Mobility
		Level of Confidence
		Perception of Cause and Effect
		Quality of Decisions
		Quality of Plan
		Risk Propensity
		Speed of Command
		Speed of Decision
		Speed of Planning
		Synchronization of Actions
		Synchronization of Decisions
		Task Competency
		Timeliness of Individual Decisions
		Training

Table B-4: "Track" Value

"Target" Event		
High Value	**Medium Value**	**Low Value**
Improve Commander's COA selection and dissemination process		
Accuracy of Collective Awareness	Completeness of Information	Atmospheric Weather
Accuracy of Intersection Awareness	Completeness of Shared Information	Accuracy of Individual Decisions
Awareness about Capabilities	Consistency of Information	Appropriateness o f Individual Decisions
Awareness about Environment	Consistency of Shared Information	Authentication
Awareness about Forces	Correctness of Individual Information	C2 Doctrine
Awareness about Intentions	Correctness of Shared Information	Communication of Intent
Awareness about Mission	Command Approach	Constraint Enforcement
Currency of Individual Information	Constraint Setting	Control Approach
Currency of Information	Criticality	Data Interoperability
Currency of Shared Information	Direct Sensing	Distribution of Information
Lethal Effectors	Information about Environment	Decision Participants
Non-Lethal Effectors	Information about Forces	Degree of Decision Concurrence
Political Situation	Indirect Sensing	Dynamics across time
Social Situation	Information about Mission	Extent of Shared Information
	Information Uncertainty	Experience of Personnel
	Likelihood of Success	Flexibility
	Risk Propensity	Force Effectiveness
	Robustness	Information Quality
	Sensor Persistence	Identification
	Speed of Command	Individual Task Efficiency
	Synchronization	Mission Effectiveness
	Synchronization of Actions	Nature of Rules
	Task Speed	Political Situation
	Trust in Information	Precision of Individual Information
	Uncertainty of Shared Information	Precision of Information
	Willingness	Precision of Shared Information
		Quality of Decisions
		Quality of Plan
		Relevance of Shared Information
		Resource Allocation
		Resource Prioritization
		Responsiveness
		Role of Authority
		Share Information
		Skill
		Sensor Coverage (Medium)
		Sensor Coverage (Spacial)
		Sensor Coverage (Spectrum)
		Space Weather
		Task Competence
		Task Efficiency
		Task Knowledge
		Timeliness of Individual Decisions
		Timeliness of Individual Information
		Timeliness of Information
		Timeliness of Shared Information
		Training
		Uncertainty of Individual Decisions

Table B-5: "Target" Value

"Engage" Event		
High Value	**Medium Value**	**Low Value**
Better optimized use of the battlespace environment		
	Atmospheric Weather	Complicated-ness
	Communications Interoperability	Data Interoperability
	Direct Sensing	Network Availability
	Indirect Sensing	Network Reach
	Space Weather	Network Reliability
		Network Richness
		Political situation
		Quality of communications Equipment
		Quality of Computing Equipment
		Selectivity
		Social Situation
Real-time collaboration among all C2 entities		
	Completeness of Shared Information	Completeness of Individual Information
	Correctness of Shared Information	Correctness of Information
	Currency of Shared Information	Currency of Individual Information
	Distribution of Information	Currency of Information
	Extent of Shared Information	Information about Environment
	Relevance of shared Information	Information about Forces
	Timeliness of Shared Information	Information about Intentions
	Trust in Information	Information about Mission
	Uncertainty of Shared Information	Information Quality
		Precision of Individual Information
		Precision of Information
		Timeliness of Information
Conduct real-time effects-based mission execution		
Awareness about Capabilities		Completeness of Individual Awareness
Awareness about Environment		Correctness of Collective Awareness
Awareness about Forces		Currency of Collective Awareness
Awareness about Intentions		Currency of Individual Awareness
Awareness about Mission		Shared Awareness (intersection)
Capability to achieve self-synchronization of forces		
Lethal effectors	Adaptiveness	Accuracy
Mission Effectiveness	C2 Doctrine	Authentication
Non-Lethal Effectors	Command Approach	Clarity about roles
Speed of Command	Command Arrangements	Constraint Enforcement
Speed of Decision	Communication of Intent	Constraint Setting
Task Competence	Control Approach	Completeness of Collective Understanding
Task Efficiency	Dynamics across Time	Correctness of Collective Understanding
Task Knowledge	Force Will	Criticality
Task Speed	Leadership	Currency of Collective Understanding
	Mobility	Experience of Personnel
	Resource Prioritization	Extent of Shared Information
	Role of Authority	Identification
	Risk Propensity	Level of Confidence
	Robustness	Likelihood of Success
	Synchronization	Nature of Rules
	Synchronization of Actions	Perception of Cause and Effect
	Team Culture	Political situation
	Team Decisions	Quality of Understanding
	Training	Resource Allocation
	Trust in Information	Responsiveness
	Trust in People	Role of Emotion
		Selectivity
		Skill
		Sleep Deprivation
		Social Situation
		State of Mental Health
		State of Physical Health
		Stress Level
		Uncertainty of Individual Understanding
		Willingness

Table B-6: "Engage" Value

"Assess" Event		
High Value	**Medium Value**	**Low Value**
Real-time Red, Blue Gray force status assessment		
Awareness about Capabilities	Accuracy of Collective Awareness	Constraint Enforcement
Awareness about Environment	Accuracy of Individual Awareness	Constraint Setting
Awareness about Forces	Accuracy of Intersection Awareness	Experience of Personnel
Awareness about Intentions	Accuracy of Partial Awareness	History
Awareness about Mission	Collective Knowledge	Identification
Correctness of Collective Awareness	Completeness of Individual Awareness	Lethal Effectors
Correctness of Individual Awareness	Political Situation	Non-Lethal Effectors
Correctness of Intersection Awareness	Precision of Collective Awareness	Number of Mental Models
Correctness of Partial Awareness	Precision of Individual Awareness	Policy Effectiveness
	Social Situation	Stress Level
	Uncertainty	Team Culture
		Team Sensemaking Behavior
Ability to accurately assess air and space operational impacts of physical environmental conditions		
Correctness of Individual Information	Precision of Individual Information	Accuracy of Shared Information
Correctness of Information	Precision of Information	Completeness of Individual Information
Correctness of Shared Information	Precision of Shared Information	Completeness of Shared Information
Currency of Information	Trust in Information	Extent of Shared Information
Currency of Shared Information		Fusion
		Information About Capabilities
		Information about Environment
		Information about Forces
		Information about Intentions
		Information Ambiguity
		Information Complexity
		Information about Mission
		Information Quality
		Information Uncertainty
		Relevance of Shared Information
		Timeliness of Shared Information
		Timeliness of Information
		Uncertainty of Shared Information
Improve COA evaluation and requirements process		
Correctness of Collective Understanding	Accuracy of Collective Understanding	Completeness of Collective Understanding
Correctness of Individual Understanding	Accuracy of Individual Understanding	Completeness of Individual Understanding
Correctness of Intersection Understanding	Accuracy of Intersection Understanding	Completeness of Partial Understanding
Correctness of Partial Understanding	Accuracy of Partial Understanding	Precision of Collective Understanding
Understanding about Capabilities	Extent of Collective Understanding	Precision of Individual Understanding
Understanding about Environment	Extent of Intersection Understanding	
Understanding about Forces	Extent of Partial Understanding	
Understanding about Intentions		
Understanding about Mission		
Rapid assessment and selection of targets to maximize desired effects		
Mission Effectiveness	Analyze	Constraint Enforcement
Task Competence	Assessment	Constraint Setting
Task Efficiency	Likelihood of Success	Discovery
Task Knowledge	Lethal Effectors	Identification
Task Speed	Non-Lethal Effectors	Innovation
		Level of Confidence
		Persistence
		Stress Level

Table B-7: "Assess" Value

APPENDIX C

Table C-1 lists the top five values of the C2 Conceptual Model Variables within each of the seven "events" contained within the AF2T2EA "Kill-Chain" process.

AF2T2EA Event	Top Five Conceptual Model Variables
Anticipate	1) *Understanding* about Environment , Intentions
	2) *Uncertainty*
	3) *Information* about Forces, Environment, Intentions, Uncertainty
	4) *Awareness* about Forces, Environment, Intentions, Mission)
	5) *Correctness* of Information, Individual Information, Shared Information
Find	1) *Sensor* Persistence, Coverage
	2) *Correctness* of Information, Individual Information, Shared Information
	3) *Timeliness* of Information, Individual Information, Shared Information
	4) *Awareness* about Forces, Environment, Intentions, Mission
	5) *Speed* of Command, Decisions, Planning, Task
Fix	1) *Correctness* of Information, Shared Information
	2) *Precision* of Information, Individual Information, Shared Information
	3) *Timeliness* of Information, Individual Information, Shared Information
	4) *Accuracy* of Individual Awareness, Individual Understanding, Collective Understanding
	5) *Level* of Confidence
Track	1) *Correctness* of Individual information, Shared Information, Individual Awareness Collective Awareness, Partial Awareness, Individual Understanding, Partial Understanding, Collective Understanding
	2) *Accuracy* of Shared Information, Individual Awareness, Collective Awareness, Partial Awareness, Intersection Awareness, Individual Understanding, Partial Understanding, Collective Understanding, Intersection Understanding
	3) *Understanding* about Forces, Environment, Mission, Intentions
	4) *Sensor* Persistence, Coverage
	5) *Timeliness* of Information, Individual Information, Shared Information, Individual Awareness, Collective Awareness, Individual Understanding, Collective Understanding
Target	1) *Accuracy* of Collective Awareness, Intersection Awareness
	2) *Currency* of Information, Individual Information, Shared Information
	3) *Effectors:* Lethal, Non-lethal
	4) *Situation:* Political, Social
	5) *Awareness* about Forces, Environment, Intentions, Mission
Engage	1) *Awareness* about Capabilities, Forces, Environment, Intentions, Mission
	2) *Speed* of: Command, Decision
	3) *Task*: Competence, Efficiency, Knowledge, Speed
	4) *Mission Effectiveness*
	5) *Effectors:* Lethal, Non-lethal
Assess	1) *Understanding* about Capabilities, Forces, Environment, Mission, Intentions
	2) *Awareness* about Capabilities, Forces, Environment, Intentions, Mission
	3) *Correctness* of Information, Individual Information, Shared Information, Individual Awareness, Collective Awareness, Partial Awareness, Intersection Awareness, Individual Understanding, Collective Understanding, Partial Understanding, Intersection Understanding
	4) *Task*: Competence, Efficiency, Knowledge, Speed
	5) *Mission Effectiveness*

Table C-1: Top Five Variables of the AF2T2EA Process

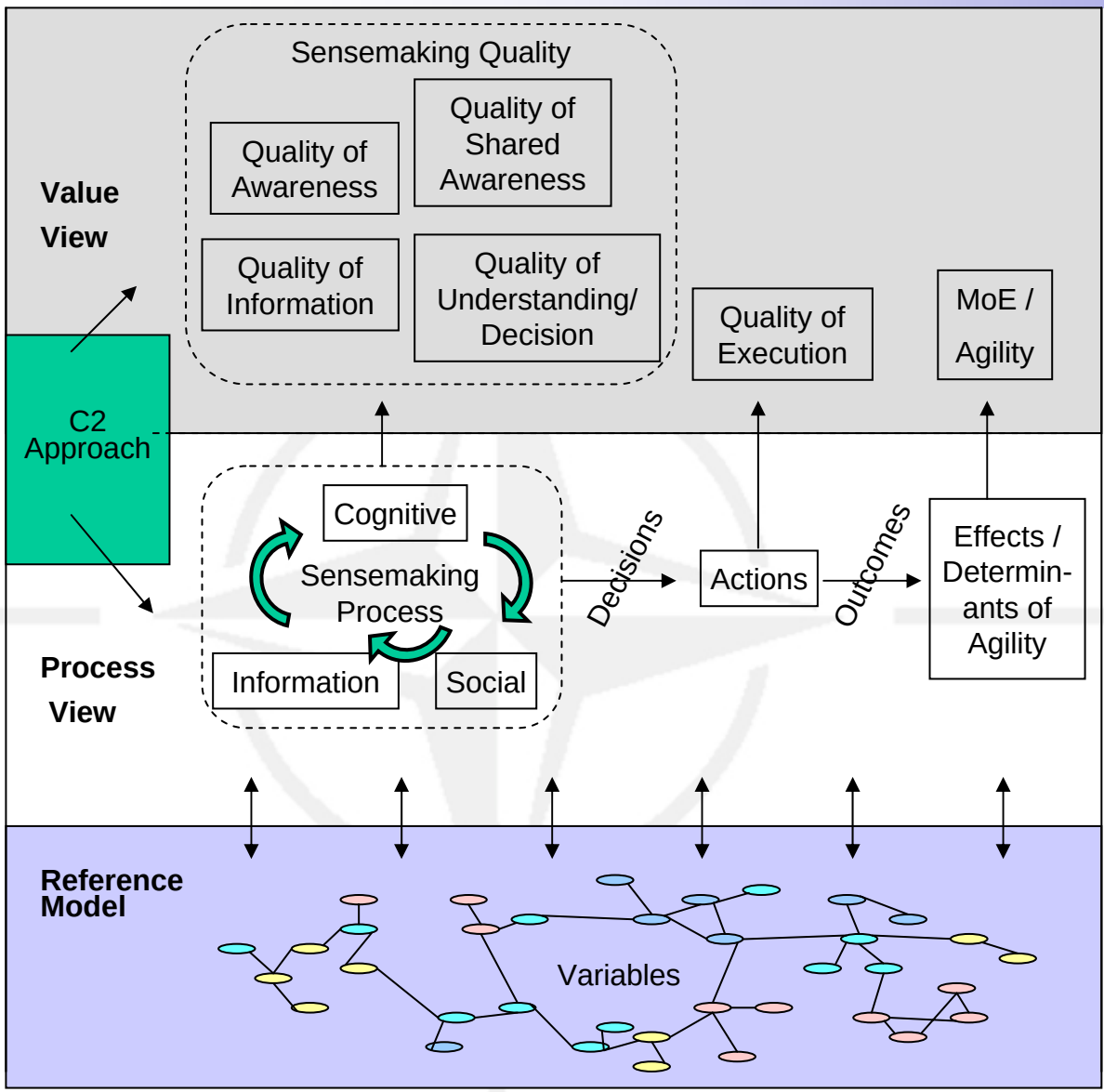

AIR FORCE RESEARCH LABORATORY

AF2T2EA
An Illustrative Example

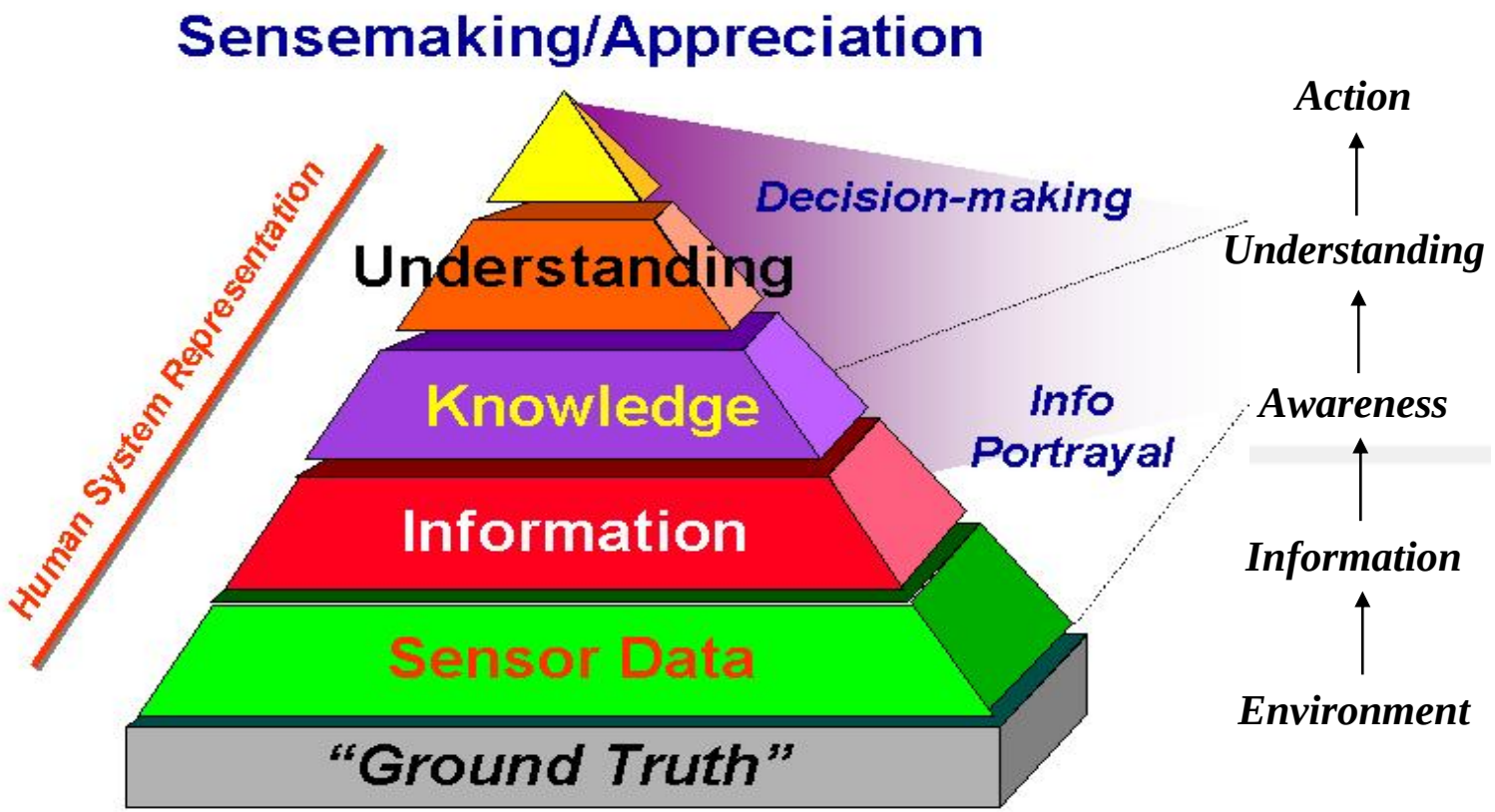
22 June 2006

Dr. Paul W. Phister, Jr., PE
Senior Strategic Planner
Information Directorate
Air Force Research Laboratory

Model Structure



Cognitive Pyramid



As of May 2005

AF2T2EA Overview

- *Current process:*
  - *Lengthy process to: Anticipate, Find, Fix, Track, Target, Engage, Assess*
  - *Serial set of processes*
- *Desired Attributes*
  - Focused, persistent C2ISR for all target categories, to achieve desired effects
  - C2 of ISR assets to persistently track target entities to predict the adversary's courses of action in the battlespace
  - Full-spectrum, networked ISR focused by anticipation in order to re-detect potential targets
  - C2 of ISR to cross-cue assets to precisely geo-locate targets
  - Networked, multi-sensor inputs to characterize a target's operational, physical, functional capabilities, and tactical employment patterns
  - Share information across entire operational network (i.e., collaboration)
  - C2 of ISR assets to persistently track target entities to lead to other target entities
  - Dynamic C2ISR network to enable target engagement at time and place of choosing
  - NRT automated C2 of forces to provide consistent ROE and with human-in-the-loop
  - Automated, machine-to-machine dialogue passing precise decision quality data/information across network to coalition assets
  - NRT and dynamic C2 of ISR assets and collection planning and tasking to execute battle damage assessment of operational effects
  - Deliver information in NRT across network of sensors, decision makers, and strikers to shorten AF2T2EA cycle

As of May 2005

Selected AF2T2EA Capabilities

A

- **Ability to model, predict and display possible effects and threats**
- **Anticipate adversary's actions in order to streamline and shorten AF2T2EA cycle**
- **Ability to model and predict CBRNE and TIM threats and events**
- **Predict how (Red, Blue, Gray) actions will cascade into direct/indirect effects in support EBO**
- **Requires correct, current, consistent and shared information**

F

- **Fully merge and integrate sensor/information to support battlespace SA**
- **Accurate/real-time battlespace SA, enabling decision makers to correctly react to changes**
- **Rapidly and accurately update situational understanding as a result of changes in SA awareness**

F

- **Accurate and timely positive combat identification of surface, air, and space objects**

T

- **Integration/display and availability of operations information in a common operational picture**
- **Improve, automate, and streamline monitoring of friendly surface, air and space force location**

T

- **Improve Commander's COA selection and dissemination process**

E

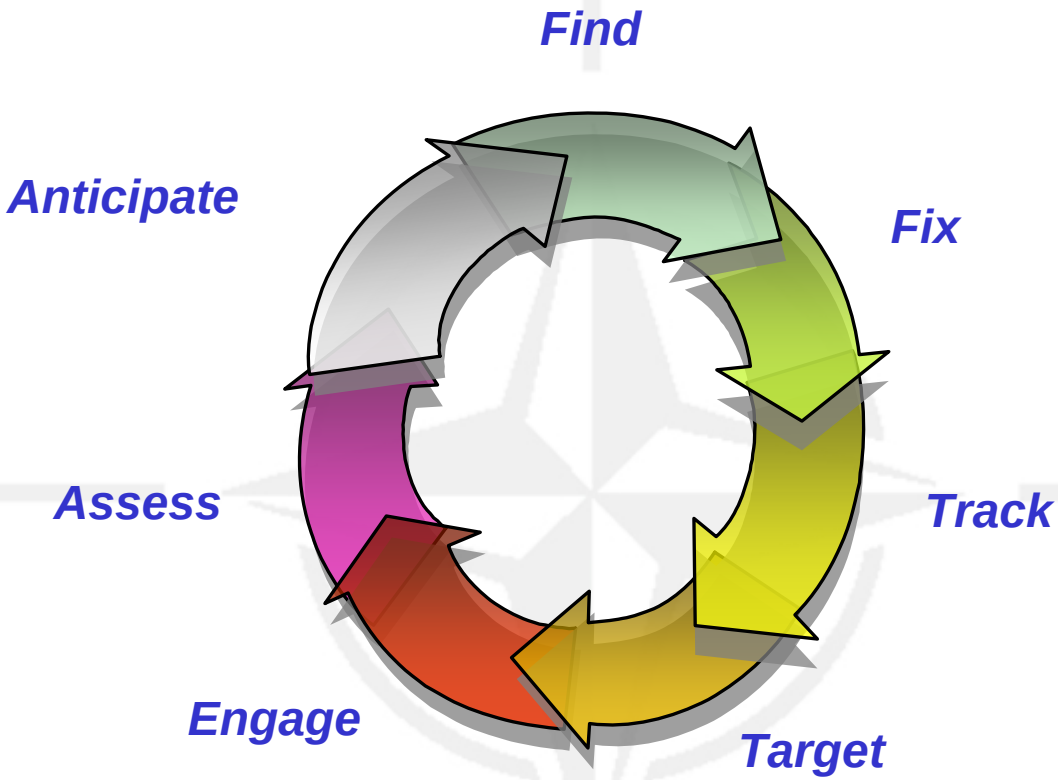
- **Better optimized use of the battlespace environment**
- **Conduct real-time effects-based mission execution**
- **Real-time collaboration among all C2 entities**
- **Capability to achieve self-synchronization of forces**

A

- **Real-time Red, Blue Gray force status assessment**
- **Rapid assessment and selection of targets to maximize desired effects**
- **Ability to accurately assess surface/air/space impacts of physical environmental conditions**
- **Improve COA evaluation and requirements process**

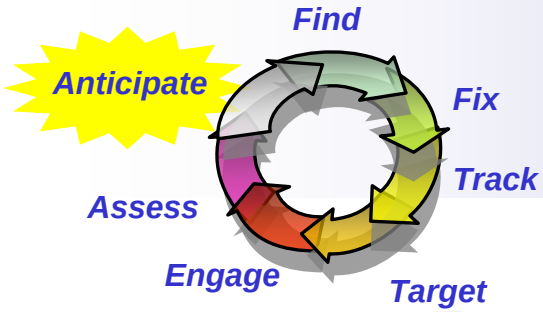
As of May 2005

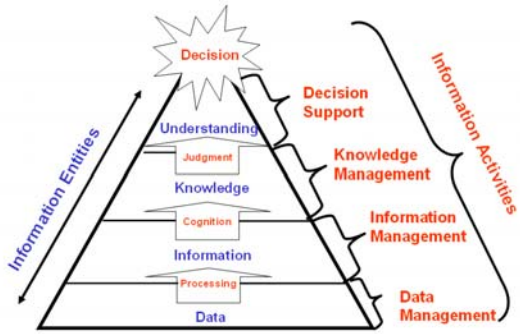
Part 1:
CM Variable Mapping to AF2T2EA Events



"Anticipate" Event

As of May 2005





Environment

- *Atmospheric Weather*
- *Space Weather*
- *Sensor Persistence*
- *Sensor Coverage (Spacial)*
- *Sensor Coverage (Medium)*
- *Sensor Coverage (Spectrum)*

Awareness

- *Accuracy of Individual Awareness*
- *Accuracy of Shared Information*
- *Awareness about Environment*
- *Awareness about Forces*
- *Awareness about Intentions*
- *Awareness about Mission*
- *Collaboration about Environment*
- *Collaboration about Forces*
- *Collaboration about Intentions*
- *Command Approach*
- *Experience of Personnel*
- *Frequency of Command Interactions*
- *Frequency of Peer-to-Peer Interactions*
- *History*
- *Quality of Interactions*
- *Quality of Peer-to-Peer Interactions*

Understanding

- *Understanding about Environment*
- *Understanding about Intentions*

Information

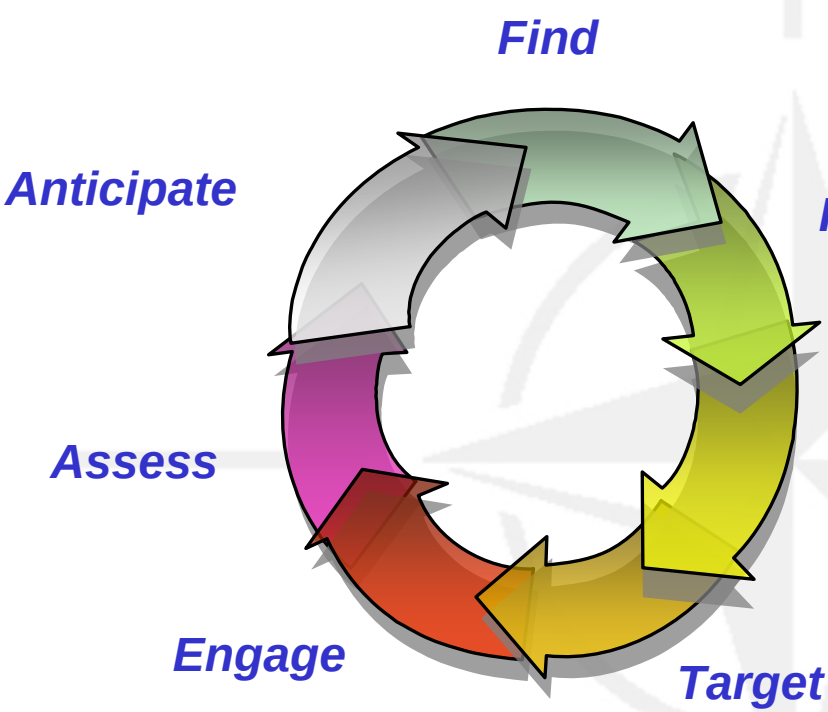
- *Accuracy*
- *Completeness of Information*
- *Completeness of Individual Information*
- *Completeness of Shared Information*
- *Correctness of Information*
- *Correctness of Individual Information*
- *Correctness of Shared Information*
- *Currency of Information*
- *Currency of Individual Information*
- *Currency of Shared Information*
- *Consistency of Information*
- *Consistency of Individual Information*
- *Consistency of Shared Information*
- *Data Interoperability*
- *Distribution of Information*
- *Extent of Shared Information*
- *Fusion*
- *Information Quality*
- *Information about Forces*
- *Information about Environment*
- *Information about intentions*
- *Information Uncertainty*
- *Network Reach*
- *Precision of Information*
- *Precision of Individual Information*
- *Precision of Shared Information*
- *Relevance of Shared Information*
- *Richness of Collaborative Environment*
- *Share Information*
- *Timeliness of Information*
- *Timeliness of Individual Information*
- *Timeliness of Shared Information*
- *Trust in Information*
- *Uncertainty*
- *Uncertainty of Shared Information*

Decision

- *Accuracy of Individual Decisions*
- *Consistency of Individual Decisions*
- *Completeness of Individual Decisions*
- *Correctness of Individual Decisions*
- *Currency of Individual Decisions*
- *Force Effectiveness*
- *Mode of Decision Making of Individual Decisions*
- *Responsiveness*
- *Precision of Individual Decisions*
- *Quality of Decisions*
- *Relevance of Individual Decisions*
- *Speed of Command*
- *Speed of Decision*
- *Speed of Planning*
- *Synchronization of Actions*
- *Task Speed*
- *Timeliness of Planning*
- *Timeliness of Individual Decisions*
- *Uncertainty of Individual Decisions*

As of May 2005

Part 2:
CM Variable Mapping to AF2T2EA Value



Looked at variable correlation

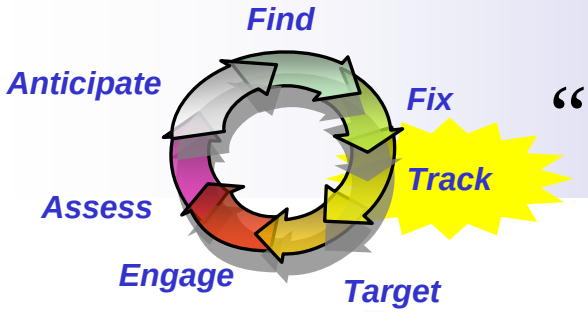
High

Medium

Low

"Track" Capabilities

As of May 2005



Integration and display of operations information in a common operational picture available to entire network

Accuracy *Adaptiveness*
Analyze
Atmospheric Weather
Dynamics across Time
History *Indirect Sensing*
Network Reach *Responsiveness*
Robustness
Accuracy of Shared Information
Completeness of Individual Information
Completeness of Information
Completeness of Shared Information
Consistency of Individual Information
Consistency of Information
Consistency of Shared Information
Correctness of Individual Information
Correctness of Shared Information
Currency of Individual Information
Currency of Information
Currency of Shared Information
Distribution of Information
Dynamics across Time

Accuracy of collective Awareness
Accuracy of Individual Awareness
Accuracy of Intersection Awareness
Accuracy of Partial Awareness
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Completeness of Individual Awareness
Consistency of Individual Awareness
Correctness of Collective Awareness
Correctness of Individual Awareness
Correctness of Partial Awareness
Currency of Collective Awareness
Currency of Individual Awareness
Precision of Individual Awareness
Timeliness of Collective Awareness
Timeliness of Individual Awareness
Uncertainty of Collective Awareness

Accuracy of Collective Understanding
Accuracy of Individual Understanding
Accuracy o f Intersection Understanding
Accuracy of Partial Understanding
Completeness of Collective Understanding
Completeness of Individual Understanding
Completeness of Intersection Understanding
Completeness of Partial Understanding
Consistency of Individual Understanding
Consistency of Intersection Understanding
Consistency of Partial Understanding
Correctness of Collective Understanding
Correctness of Individual Understanding
Correctness of Partial Understanding
Currency of Collective Understanding
Currency of Individual Understanding
Extent of collective Understanding
Extent of Partial Understanding
Shared Understanding
Timeliness of Collective Understanding
Timeliness o f Individual Understanding
Uncertainty of Collective Understanding

Extend of Shared Information
Flexibility
Fusion
Information about Environment
Information about Forces
Information about Intentions
Information Quality
Information Uncertainty
Precision of Individual Information
Precision of Information
Precision of Shared Information
Relevance o f Shared Information
Shared Understanding
Timeliness of Shared Information
Timeliness of Individual Information
Timeliness of Information
Uncertainty of Shared Information

Improve, automate, and streamline monitoring of friendly air and space force location

Adaptiveness
Analyze
Collaboration about Environment
Collaboration about Forces
Collaboration about Intentions
Collaboration about Mission
Command Approach
Distribution of Information
Dynamics across Time
Experience of Personnel

Responsiveness
Risk Propensity
Robustness
Speed of Command
Speed of Decision
Speed of Planning
Synchronization of Decisions
Synchronization of Actions
Task Competency
Task Speed

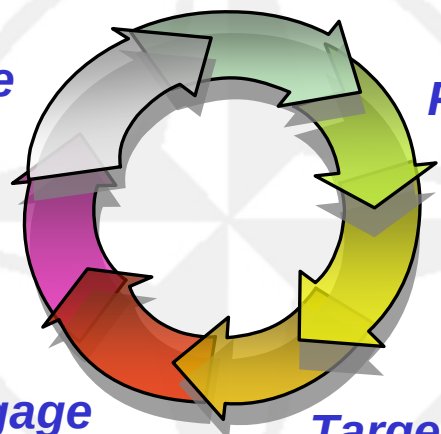
Timeliness of Individual Decisions
Training
Trust in Information
Mobility
Understanding about Environment
Understanding about Forces
Understanding about Intentions
Understanding about Mission
Flexibility

History
Innovation
Level of Confidence
Perception of Cause and Effect
Quality of Decisions
Quality of Plan
Sensor Coverage (Medium)
Sensor coverage (Spacial)
Sensor Coverage (Spectrum)
Space Weather

High Correlation
Med Correlation
Low Correlation
to
"Track"

Value View of AF2T2EA
Top 5 Variables

As of May 2005



Find
1) Sensor
2) Correctness
3) Timeliness
4) Awareness
5) Speed

Fix
1) Correctness
2) Precision
3) Timeliness
4) Accuracy
5) Level of Confidence

Track
1) Correctness
2) Accuracy
3) Understanding
4) Sensor
5) Timeliness

Target
1) Accuracy
2) Currency
3) Effectors:
4) Situation:
5) Awareness

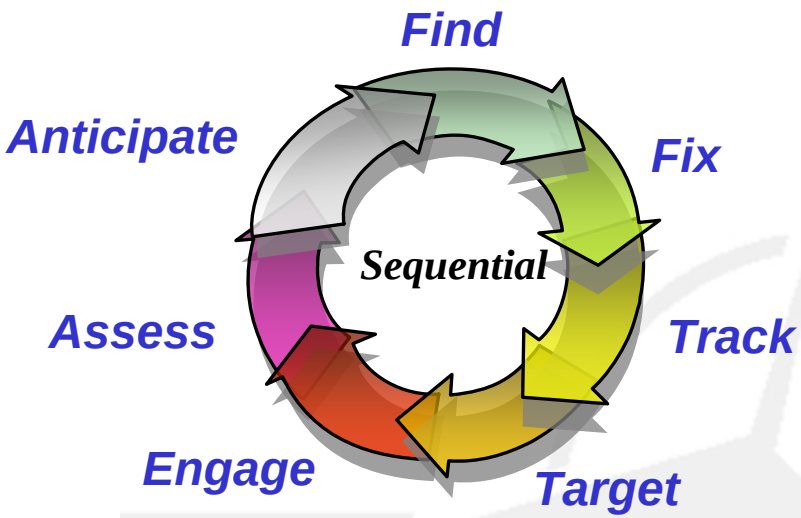
Engage
1) Awareness
2) Speed
3) Task
4) Mission Effectiveness
5) Effectors

Assess
1) Understanding
2) Awareness
3) Correctness
4) Task:
5) Mission Effectiveness

Anticipate
1) Understanding
2) Uncertainty
3) Information
4) Awareness
5) Correctness

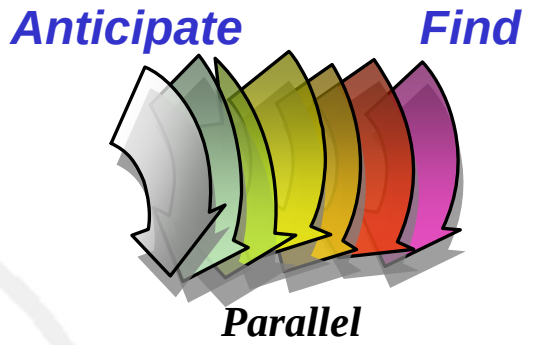
Summary

TODAY



Goal of less than 10 minutes
- AF2T2EA -

TOMORROW?



Goal of less than 1 minute
- AFEA -

- ***Matched C2 concept variables to AFT2T2EA process for verification***
- ***Good match for both the event and value view***
- ***Goal would be to use the C2 concept variables to "assist" in moving from today's to tomorrow's view***

Questions?

"Information superiority becomes a precondition for fighting to achieve air and space superiority."

LtGen Liu Shunyao

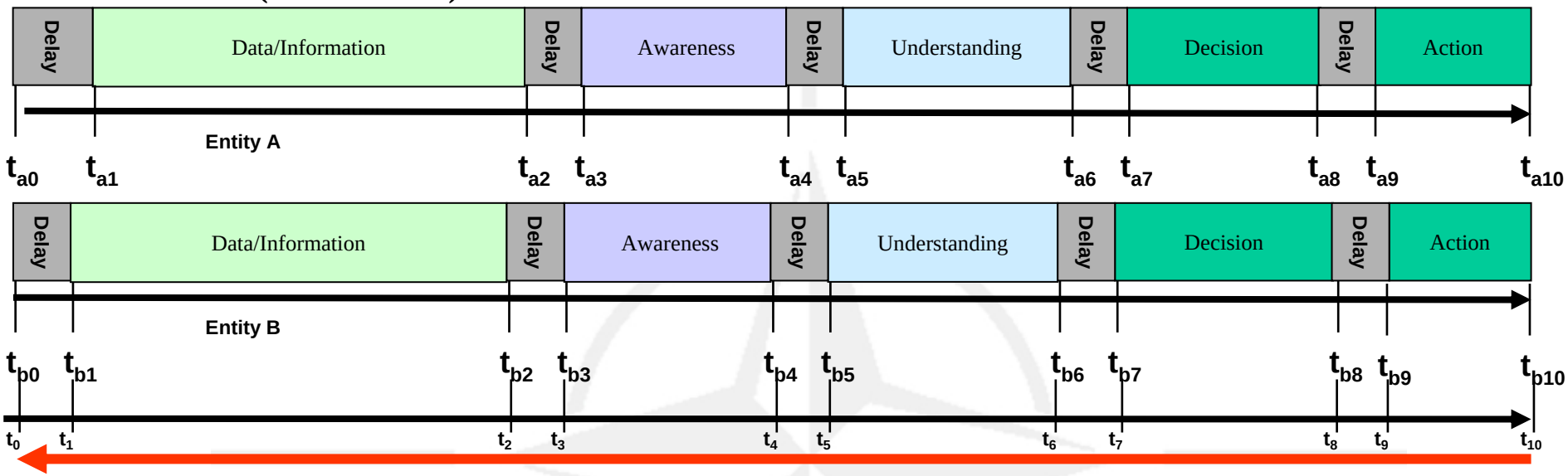
Chief, China Peoples Liberation Army Air Force

28 Feb 2000

Back Ups

Network Centric Operations Timeline Relationships

Generic Timeline (Time in Units)



Basic Times:

$t_{a2} - t_{a0}$, $t_{b2} - t_{b0}$	Time to receive, process, disseminate data/information
$t_{a4} - t_{a2}$, $t_{b4} - t_{b2}$	Time to analyze and gain awareness
$t_{a6} - t_{a4}$, $t_{b6} - t_{b4}$	Time to analyze and gain understanding
$t_{a8} - t_{a6}$, $t_{b8} - t_{b6}$	Time to analyze and make a decision (Speed of Decision)

Individual times:

$t_{a4} - t_{a0}$, $t_{b4} - t_{b0}$,	Time to Awareness
$t_{a6} - t_{a0}$, $t_{b6} - t_{b0}$,	Time to Understanding
$t_{a8} - t_{a0}$, $t_{b8} - t_{b0}$,	Time to make a Decision (Speed of Command)
$t_{a10} - t_{a0}$, $t_{b10} - t_{b0}$,	Time to Action (Speed of Action)

Collaboration Times:

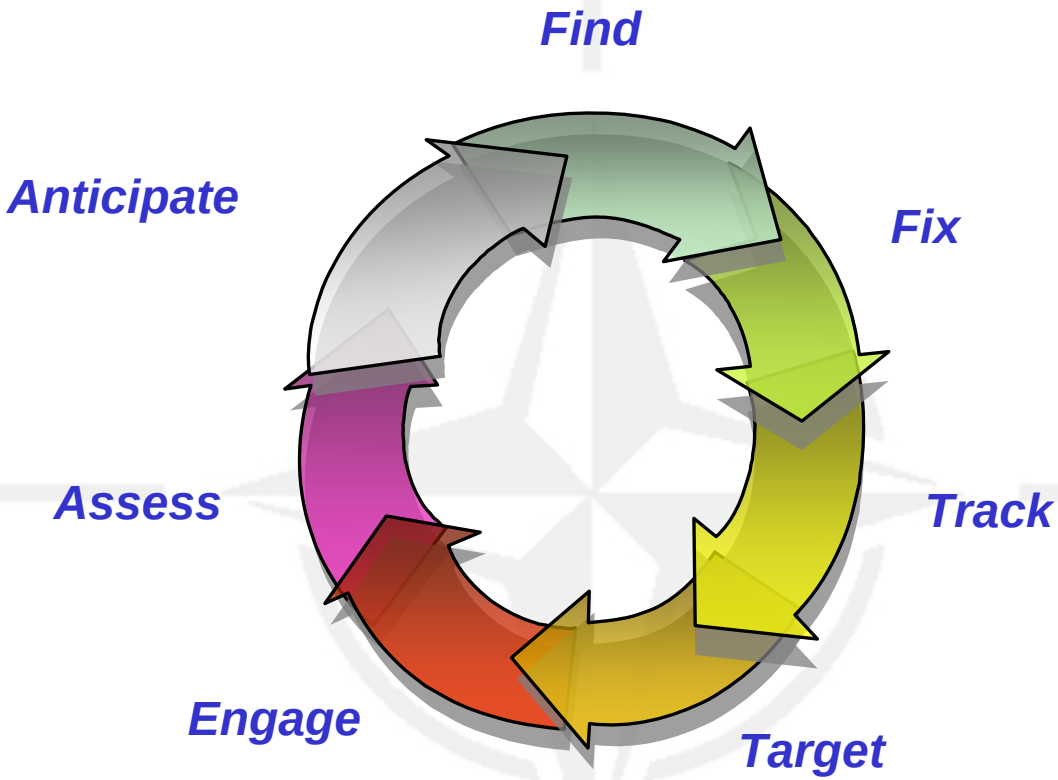
MAX(t_{a4},t_{b4}) – t_0	Time to Shared Awareness (time to achieve a collective awareness)
MAX(t_{a6},t_{b6}) – t_0	Time to Shared Understanding (time to achieve a collective understanding)
MAX(t_{a8},t_{b8}) – t_0	Time to make a Shared Decision (joint speed of decision)
MAX(t_{a10},t_{b10}) – t_0	Time to Shared Action (joint speed of action)

Definitions:

t_0	Start of particular time reference
t_8	Time collaborative decision is made
t_{a8}	Time entity A decision is made
t_{b8}	Time entity B decision is made
t_{a10}	Time to Action for entity A
t_{b10}	Time to Action for entity B
t_{a3}-t_{a0} or t_{b3}-t_{b0}	Currency of the data/information
MAX(t_{a3},t_{b3}) – t_0	Currency of the shared information
MAX(t_{a5},t_{b5}) – t_0	Currency of shared awareness
MAX(t_{a7},t_{b7}) – t_0	Currency of shared understanding
MAX(t_{a9},t_{b9}) – t_0	Currency of shared decisions
MAX(t_{a10},t_{b10}) – t_0	Currency of shared actions

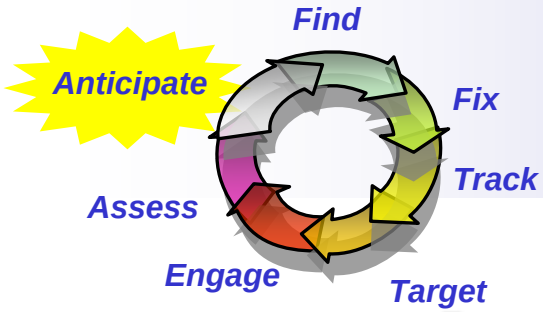
As of May 2005

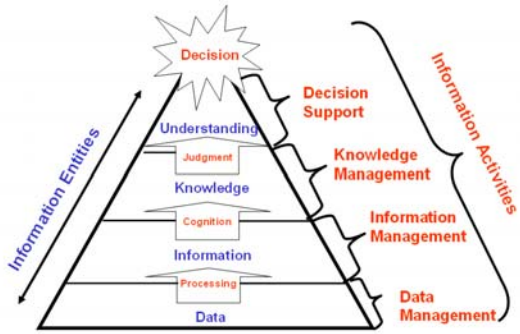
Mapping CM Variables to AF2T2EA Events



"Anticipate" Event

As of May 2005





Environment

- *Atmospheric Weather*
- *Space Weather*
- *Sensor Persistence*
- *Sensor Coverage (Spacial)*
- *Sensor Coverage (Medium)*
- *Sensor Coverage (Spectrum)*

Awareness

- *Accuracy of Individual Awareness*
- *Accuracy of Shared Information*
- *Awareness about Environment*
- *Awareness about Forces*
- *Awareness about Intentions*
- *Awareness about Mission*
- *Collaboration about Environment*
- *Collaboration about Forces*
- *Collaboration about Intentions*
- *Command Approach*
- *Experience of Personnel*
- *Frequency of Command Interactions*
- *Frequency of Peer-to-Peer Interactions*
- *History*
- *Quality of Interactions*
- *Quality of Peer-to-Peer Interactions*

Understanding

- *Understanding about Environment*
- *Understanding about Intentions*

Information

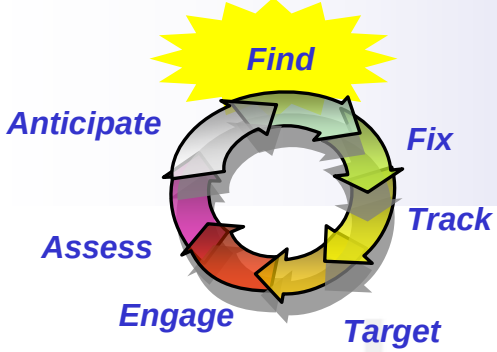
- *Accuracy*
- *Completeness of Information*
- *Completeness of Individual Information*
- *Completeness of Shared Information*
- *Correctness of Information*
- *Correctness of Individual Information*
- *Correctness of Shared Information*
- *Currency of Information*
- *Currency of Individual Information*
- *Currency of Shared Information*
- *Consistency of Information*
- *Consistency of Individual Information*
- *Consistency of Shared Information*
- *Data Interoperability*
- *Distribution of Information*
- *Extent of Shared Information*
- *Fusion*
- *Information Quality*
- *Information about Forces*
- *Information about Environment*
- *Information about intentions*
- *Information Uncertainty*
- *Network Reach*
- *Precision of Information*
- *Precision of Individual Information*
- *Precision of Shared Information*
- *Relevance of Shared Information*
- *Richness of Collaborative Environment*
- *Share Information*
- *Timeliness of Information*
- *Timeliness of Individual Information*
- *Timeliness of Shared Information*
- *Trust in Information*
- *Uncertainty*
- *Uncertainty of Shared Information*

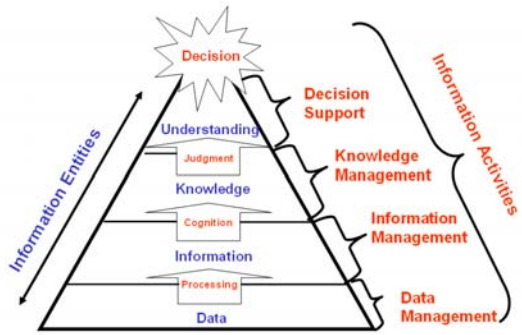
Decision

- *Accuracy of Individual Decisions*
- *Consistency of Individual Decisions*
- *Completeness of Individual Decisions*
- *Correctness of Individual Decisions*
- *Currency of Individual Decisions*
- *Force Effectiveness*
- *Mode of Decision Making of Individual Decisions*
- *Responsiveness*
- *Precision of Individual Decisions*
- *Quality of Decisions*
- *Relevance of Individual Decisions*
- *Speed of Command*
- *Speed of Decision*
- *Speed of Planning*
- *Synchronization of Actions*
- *Task Speed*
- *Timeliness of Planning*
- *Timeliness of Individual Decisions*
- *Uncertainty of Individual Decisions*

"Find" Event

As of May 2005





Environment

Atmospheric Weather
Space Weather
Sensor Persistence
Sensor Coverage (Spacial)
Sensor Coverage (Medium)
Sensor Coverage (Spectrum)

Awareness

Accuracy of Individual Awareness
Accuracy of Shared Information
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Collaboration about Environment
Collaboration about Forces
Collaboration about Intentions
Command Approach
Experience of Personnel
Frequency of Command Interactions
Frequency of Peer-to-Peer Interactions
History
Quality of Interactions
Quality of Peer-to-Peer Interactions

Understanding

Understanding about Environment
Understanding about Intentions

Information

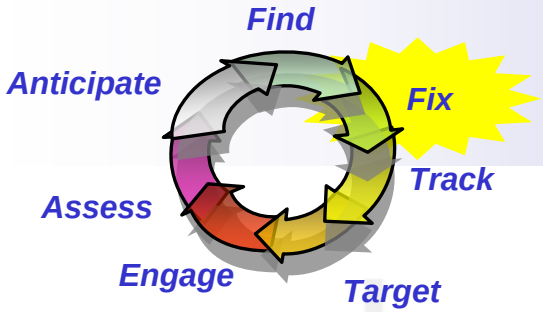
Accuracy
Completeness of Information
Completeness of Individual Information
Completeness of Shared Information
Correctness of Information
Correctness of Individual Information
Correctness of Shared Information
Currency of Information
Currency of Individual Information
Currency of Shared Information
Consistency of Information
Consistency of Individual Information
Consistency of Shared Information
Data Interoperability
Distribution of Information
Extent of Shared Information
Fusion
Information Quality
Information about Forces
Information about Environment
Information about intentions
Information Uncertainty
Network Reach
Precision of Information
Precision of Individual Information
Precision of Shared Information
Relevance of Shared Information
Richness of Collaborative Environment
Share Information
Timeliness of Information
Timeliness of Individual Information
Timeliness of Shared Information
Trust in Information
Uncertainty
Uncertainty of Shared Information

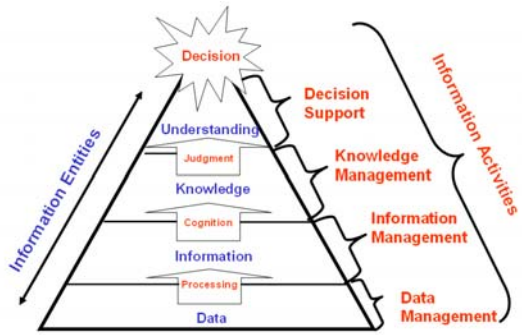
Decision

Accuracy of Individual Decisions
Consistency of Individual Decisions
Completeness of Individual Decisions
Correctness of Individual Decisions
Currency of Individual Decisions
Force Effectiveness
Mode of Decision Making of Individual Decisions
Responsiveness
Precision of Individual Decisions
Quality of Decisions
Relevance of Individual Decisions
Speed of Command
Speed of Decision
Speed of Planning
Synchronization of Actions
Task Speed
Timeliness of Planning
Timeliness of Individual Decisions
Uncertainty of Individual Decisions

"Fix" Event

As of May 2005





Environment

Analyze
Network Availability
Network Reach
Network Reliability
Quality of Communications Equipment
Quality of Computing Equipment
Sensor Coverage (Spacial)
Sensor Coverage (Medium)
Sensor Coverage (Spectrum)
Sensor Persistence

Awareness

Accuracy of Individual Awareness
Adaptiveness
Awareness about Capabilities
Awareness about Intentions
Identification
Level of Confidence
Task Competence

Decision

Command Approach
Completeness of Individual Decisions
Identification
Level of Confidence
Mission Effectiveness
Task Competence
Task Speed

Information

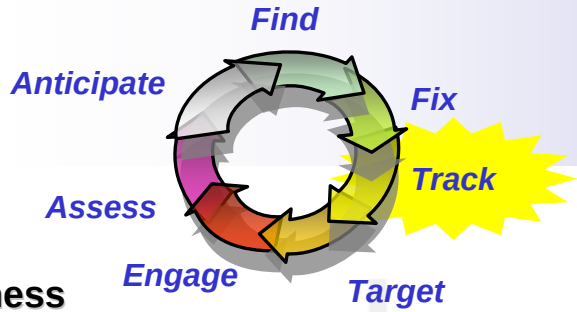
Accuracy
Authentication
Completeness of Information
Consistency of Information
Consistency of Shared Information
Correctness of Information
Correctness of Shared Information
Currency of Shared Information
Distribution of Information
Extend of Shared Information
Fusion
Identification
Information About Capabilities
Information Ambiguity
Information Complexity
Information Quality
Information Uncertainty
Precision of Individual Information
Precision of Information
Precision of Shared Information
Relevance of Shared Information
Share Information
Timeliness of Shared Information
Timeliness of Individual Information
Timeliness of Information
Uncertainty of Shared Information

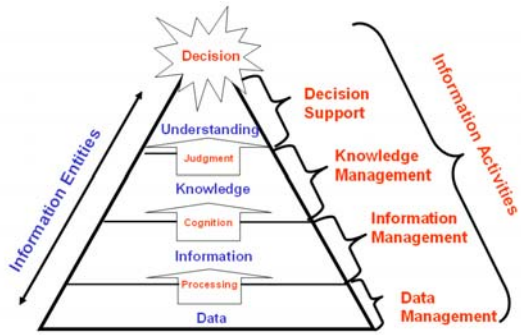
Understanding

Accuracy of Collective understanding
Accuracy of Individual Understanding
Collective Knowledge
Completeness of Collective Understanding
Identification
Level of Confidence

"Track" Event

As of May 2005





Environment

Accuracy
Adaptiveness
Responsiveness
Analyze
Atmospheric Weather
Dynamics across Time
History
Indirect Sensing
Mobility
Network Reach
Robustness
Sensor Coverage (Medium)
Sensor coverage (Spacial)
Sensor Coverage (Spectrum)
Space Weather

Awareness

Accuracy of collective Awareness
Accuracy of Individual Awareness
Accuracy of Intersection Awareness
Accuracy of Partial Awareness
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Completeness of Individual Awareness
Consistency of Individual Awareness
Correctness of Collective Awareness
Correctness of Individual Awareness
Correctness of Partial Awareness
Currency of Collective Awareness
Currency of Individual Awareness
Precision of Individual Awareness
Timeliness of Collective Awareness
Timeliness of Individual Awareness
Uncertainty of Collective Awareness

Information

Accuracy
Accuracy of Shared Information
Completeness of Individual Information
Completeness of Information
Completeness of Shared Information
Consistency of Individual Information
Consistency of Information
Consistency of Shared Information
Currency of Shared Information
Currency of Individual Information
Currency of Information
Correctness of Individual Information
Correctness of Shared Information
Distribution of Information
Dynamics across Time
Extend of Shared Information
Flexibility
Fusion
Information about Environment
Information about Forces
Information about Intentions
Information Quality
Information Uncertainty
Precision of Individual Information
Precision of Information
Precision of Shared Information
Relevance o f Shared Information
Shared Understanding
Timeliness of Shared Information
Timeliness of Individual Information
Timeliness of Information
Uncertainty of Shared Information

Understanding

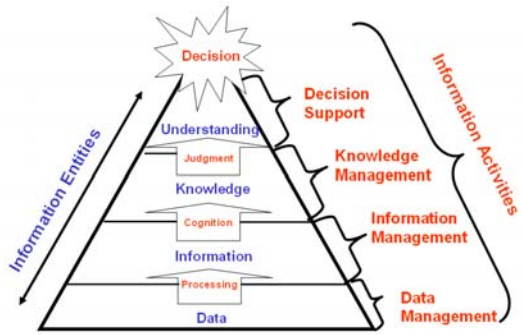
Accuracy of Collective Understanding
Accuracy of Individual Understanding
Accuracy o f Intersection Understanding
Accuracy of Partial Understanding
Completeness of Collective Understanding
Completeness of Individual Understanding
Completeness of Intersection Understanding
Completeness of Partial Understanding
Consistency of Individual Understanding
Consistency of Intersection Understanding
Consistency of Partial Understanding
Correctness of Collective Understanding
Correctness of Individual Understanding
Correctness of Partial Understanding
Currency of Collective Understanding
Currency of Individual Understanding
Extent of collective Understanding
Extent of Partial Understanding
Shared Understanding
Timeliness of Collective Understanding
Timeliness o f Individual Understanding
Uncertainty of Collective Understanding

Decision

Adaptiveness
Analyze
Collaboration about Environment
Collaboration about Forces
Collaboration about Intentions
Collaboration about Mission
Command Approach
Distribution of Information
Dynamics across Time
Experience of Personnel
Flexibility
History
Innovation
Level of Confidence
Perception of Cause and Effect
Quality of Decisions
Quality of Plan
Responsiveness
Risk Propensity
Robustness
Speed of Command
Speed of Decision
Speed of Planning
Synchronization of Decisions
Synchronization of Actions
Task Competency
Task Speed
Timeliness of Individual Decisions
Training
Trust in Information
Understanding about Environment
Understanding about Forces / Intentions / Mission

"Target" Event

As of May 2005



Environment

- *Atmospheric Weather*
- *Direct Sensing*
- *Indirect Sensing*
- *Political Situation*
- *Sensor Coverage (Medium)*
- *Sensor Coverage (Spacial)*
- *Sensor Coverage (Spectrum)*
- *Sensor Persistence*
- *Social Situation*
- *Space Weather*

Awareness

- *Accuracy of Collective Awareness*
- *Accuracy of Intersection Awareness*
- *Awareness about Capabilities*
- *Awareness about Environment*
- *Awareness about Forces*
- *Awareness about Intentions*
- *Awareness about Mission*

Understanding

- *Quality of Understanding*

Information

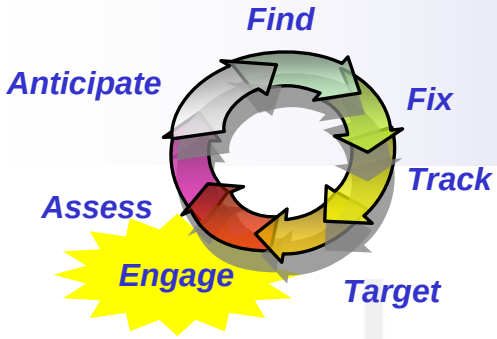
- *Completeness of Information*
- *Completeness of Shared Information*
- *Consistency of Information*
- *Consistency of Shared Information*
- *Correctness of Individual Information*
- *Correctness of Shared Information*
- *Currency of Individual Information*
- *Currency of Information*
- *Currency of Shared Information*
- *Data Interoperability*
- *Distribution of Information*
- *Extent of Shared Information*
- *Information about Environment*
- *Information about Forces*
- *Information about Mission*
- *Information Quality*
- *Information Uncertainty*
- *Precision of Individual Information*
- *Precision of Information*
- *Precision of Shared Information*
- *Relevance of Shared Information*
- *Share Information*
- *Timeliness of Shared Information*
- *Timeliness of Individual Information*
- *Timeliness of Information*
- *Trust in Information*
- *Uncertainty of Shared Information*

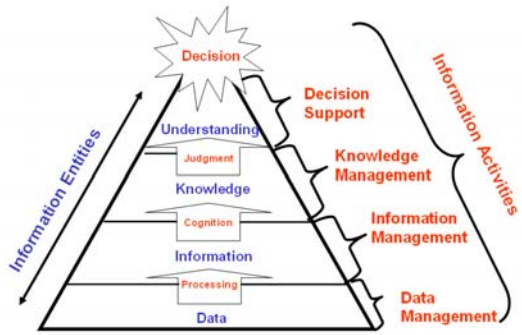
Decision

- *Accuracy of Individual Decisions*
- *Appropriateness o f Individual Decisions*
- *Authentication*
- *Command Approach*
- *C2 Doctrine*
- *Communication of Intent*
- *Constraint Enforcement*
- *Criticality*
- *Constraint Setting*
- *Control Approach*
- *Decision Participants*
- *Degree of Decision Concurrence*
- *Dynamics across time*
- *Experience of Personnel*
- *Flexibility*
- *Force Effectiveness*
- *Identification*
- *Indirect Sensing*
- *Individual Task Efficiency*
- *Lethal Effectors*
- *Likelihood of Success*
- *Mission Effectiveness*
- *Nature of Rules*
- *Non-Lethal Effectors*
- *Political Situation*
- *Quality of Decisions*
- *Quality of Plan*
- *Resource Allocation*
- *Resource Prioritization*
- *Responsiveness*
- *Risk Propensity*
- *Robustness*
- *Role of Authority*
- *Skill*
- *Task Speed*
- *Social Situation*
- *Speed of Command*
- *Synchronization*
- *Synchronization of Actions*
- *Task Competence*
- *Task Efficiency*
- *Task Knowledge*
- *Timeliness of Individual Decisions*
- *Training*
- *Trust in Information*
- *Uncertainty of Individual Decisions*
- *Willingness*

"Engage" Event

As of May 2005





Environment

Atmospheric Weather
Communications Interoperability
Complicated-ness
Data Interoperability
Network Availability
Network Reach
Network Reliability
Network Richness
Political situation
Quality of communications Equipment
Quality of Computing Equipment
electivity
Social Situation

Awareness

Awareness about Capabilities
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Completeness of Individual Awareness
Correctness of Collective Awareness
Currency of Collective Awareness
Currency of Individual Awareness
Shared Awareness (intersection)

Understanding

Completeness of Collective Understanding
Correctness of Collective Understanding
Currency of Collective Understanding
Quality of Understanding
Uncertainty of Individual Understanding

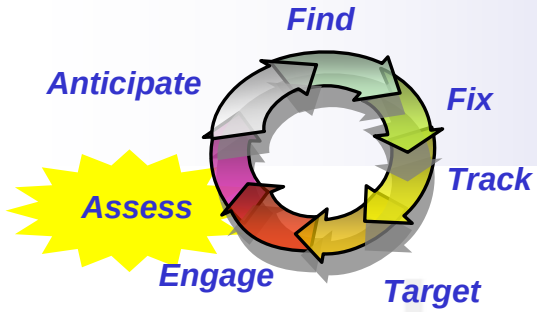
Information

Completeness of Individual Information
Completeness of Shared Information
Correctness of Information
Correctness of Shared Information
Currency of Individual Information
Currency of Information
Currency of Shared Information
Distribution of Information
Extent of Shared Information
Information about Environment
Information about Forces
Information about Intentions
Information about Mission
Information Quality
Precision of Individual Information
Precision of Information
Relevance of shared Information
Timeliness of Shared Information
Timeliness of Information
Trust in Information
Uncertainty of Shared Information

Decision

Accuracy
Adaptiveness
Authentication
C2 Doctrine
Clarity about roles
Command Approach
Command Arrangements
Communication of Intent
Constraint Enforcement
Constraint Setting
Control Approach
Criticality
Dynamics across Time
Experience of Personnel
Force Will
Extent of Shared Information
Identification
Leadership
Lethal effectors
Level of Confidence
Likelihood of Success
Mission Effectiveness
Mobility
Nature of Rules
Non-Lethal Effectors
Political situation
Resource Allocation
Perception of Cause and Effect
Trust in Information
Trust in People
Resource Prioritization
Responsiveness
Role of Authority
Risk Propensity
Robustness
Role of Emotion
Selectivity
Skill
Sleep Deprivation
Social Situation
Speed of Command
Speed of Decision
State of Mental Health
State of Physical Health
Stress Level
Synchronization
Synchronization of Actions
Task Competence
Task Efficiency
Task Knowledge
Task Speed
Team Culture
Team Decisions
Training
Willingness

"Assess" Event



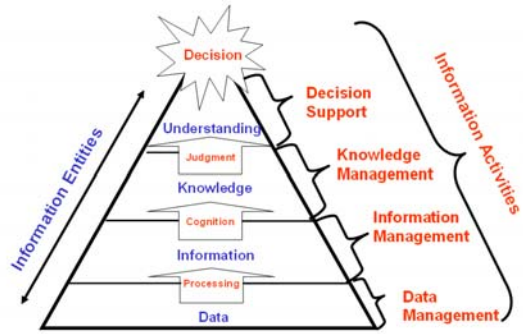
As of May 2005

Environment

Collective Knowledge
Constraint Enforcement
Constraint Setting
Experience of Personnel
History
Identification
Lethal Effectors
Non-Lethal Effectors
Number of Mental Models
Policy Effectiveness
Political Situation
Social Situation
Stress Level
Team Culture
Team Sensemaking Behavior
Uncertainty

Awareness

Accuracy of Collective Awareness
Accuracy of Intersection Awareness
Awareness about Capabilities
Awareness about Forces
Awareness about Mission
Correctness of Collective Awareness
Correctness of Intersection Awareness
Precision of Collective Awareness
Accuracy of Individual Awareness
Accuracy of Partial Awareness
Awareness about Environment
Awareness about Intentions
Completeness of Individual Awareness
Correctness of Individual Awareness
Correctness of Partial Awareness
Precision of Individual Awareness



Information

Accuracy of Shared Information
Completeness of Individual Information
Completeness of Shared Information
Correctness of Individual Information
Correctness of Information
Correctness of Shared Information
Currency of Information
Currency of Shared Information
Extent of Shared Information
Fusion
Information About Capabilities
Information about Environment
Information about Forces
Information about Intentions
Information about Mission
Information Ambiguity
Information Complexity
Information Quality
Information Uncertainty
Precision of Individual Information
Precision of Information
Precision of Shared Information
Relevance of Shared Information
Timeliness of Shared Information
Timeliness of Information
Trust in Information
Uncertainty of Shared Information

Understanding

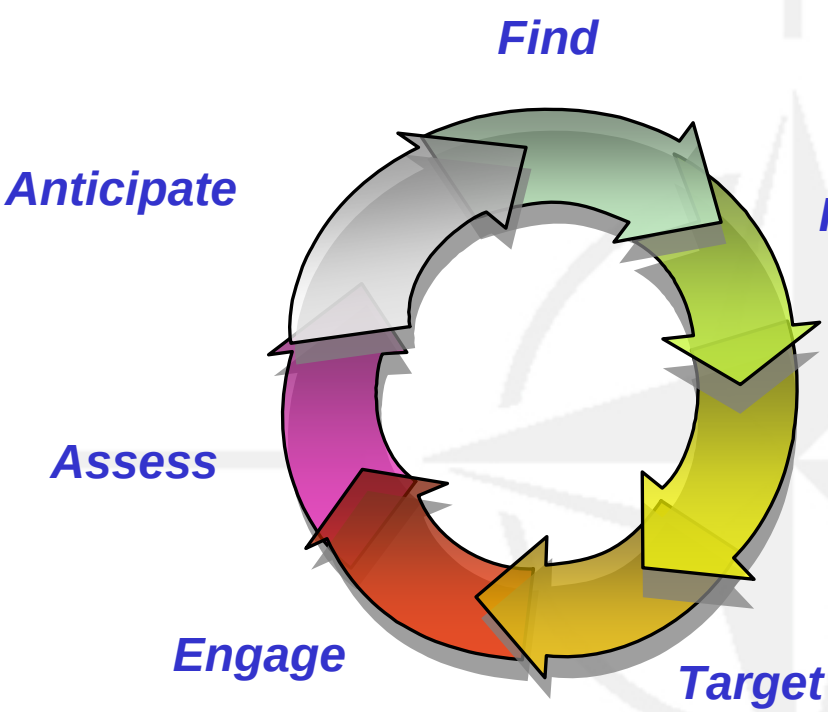
Accuracy of Collective Understanding
Accuracy of Individual Understanding
Accuracy of Intersection Understanding
Accuracy of Partial Understanding
Completeness of Collective Understanding
Completeness of Individual Understanding
Completeness of Partial Understanding
Correctness of Collective Understanding
Correctness of Individual Understanding
Correctness of Intersection Understanding
Correctness of Partial Understanding
Extent of Collective Understanding
Extent of Intersection Understanding
Extent of Partial Understanding
Precision of Collective Understanding
Precision of Individual Understanding
Understanding about Capabilities
Understanding about Environment
Understanding about Forces / Intentions / Mission

Decision

Analyze
Assessment
Constraint Enforcement
Constraint Setting
Discovery
Identification
Innovation
Level of Confidence
Likelihood of Success
Mission Effectiveness
Non-Lethal Effectors
Persistence
Stress Level
Task Competence
Task Efficiency
Task Knowledge
Task Speed

Mapping CM Variables to AF2T2EA Value

As of May 2005



Looked at variable correlation

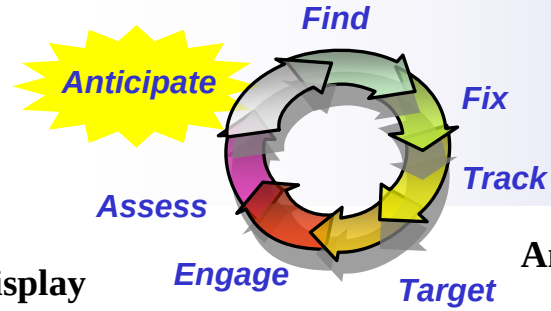
High

Medium

Low

"Anticipate" Capabilities

As of May 2005



Anticipate adversary's action(s) in order to streamline and shorten Find, Fix, Track, Target, Engage, and Assess (F2T2EA) cycle

Ability to model, predict and display possible effects, warn, and report CBRNE and TIM threats

Atmospheric Weather	*Space Weather*
Sensor Persistence	*Understanding about Intentions*
Sensor Coverage (Spacial)	*Sensor Coverage (Medium)*
Sensor Coverage (Spectrum)	*Understanding about Environment*

Predict how actions (Red, Blue, Gray) will cascade into direct and indirect effects in support of effects-based operations

Accuracy	*Information Quality*
Completeness of Information	*Information about Forces*
Completeness of Individual Information	*Information about Environment*
Completeness of Shared Information	*Information about intentions*
Correctness of Information	*Information Uncertainty*
Correctness of Individual Information	*Network Reach*
Correctness of Shared Information	*Precision of Information*
Currency of Information	*Precision of Individual Information*
Currency of Individual Information	*Precision of Shared Information*
Currency of Shared Information	*Relevance of Shared Information*
Consistency of Information	*Richness of Collaborative Environment*
Consistency of Individual Information	*Share Information*
Consistency of Shared Information	*Timeliness of Information*
Distribution of Information	*Timeliness of Individual Information*
	Timeliness of Shared Information
	Trust in Information
	Uncertainty
	Uncertainty of Shared Information
	Data Interoperability
	Fusion
	Extent of Shared Information

Experience of Personnel
Frequency of Command Interactions
Frequency of Peer-to-Peer Interactions
History
Quality of Interactions
Quality of Peer-to-Peer Interactions
Accuracy of Individual Awareness
Accuracy of Shared Information
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Collaboration about Environment
Collaboration about Forces
Collaboration about Intentions
Command Approach
Task Speed
Timeliness of Planning
Timeliness of Individual Decisions
Uncertainty of Individual Decisions

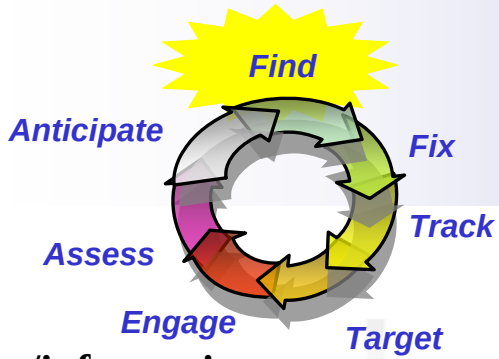
Accuracy of Individual Decisions
Consistency of Individual Decisions
Completeness of Individual Decisions
Correctness of Individual Decisions
Currency of Individual Decisions
Force Effectiveness
Mode of Decision Making of Individual Decisions
Responsiveness
Precision of Individual Decisions
Quality of Decisions
Relevance of Individual Decisions
Speed of Command
Speed of Decision
Speed of Planning
Synchronization of Actions

High Correlation
Med Correlation
Low Correlation
to
"Anticipate"

Ability to model and predict CBRNE and TIM threats and events

Atmospheric Weather	*Space Weather*
Sensor Persistence	*Understanding about Intentions*
Sensor Coverage (Spacial)	*Sensor Coverage (Medium)*
Sensor Coverage (Spectrum)	*Understanding about Environment*

As of May 2005



"Find" Capabilities

Accurate and real-time situational awareness of the battlespace to enable decision makers to correctly react to dynamic changes

Command Approach
Experience of Personnel
Accuracy of Individual Decisions
Consistency of Individual Decisions
Completeness of Individual Decisions
Correctness of Individual Decisions
Currency of Individual Decisions
Force Effectiveness
Mode of Decision Making of Individual Decisions
Responsiveness
Precision of Individual Decisions
Quality of Decisions
Relevance of Individual Decisions
Speed of Command
Speed of Decision
Speed of Planning
Synchronization of Actions
Task Speed
Timeliness of Planning
Timeliness of Individual Decisions
Uncertainty of Individual Decisions
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Accuracy of Individual Awareness
Accuracy of Shared Information
Collaboration about Forces
Collaboration about Intentions
Command Approach

High Correlation
Med Correlation
Low Correlation to "Find"

Fully merge and integrate sensor/information to support battlespace situational awareness

Atmospheric Weather
Space Weather
Sensor Persistence
Sensor Coverage (Spacial)
Sensor Coverage (Medium)
Sensor Coverage (Spectrum)

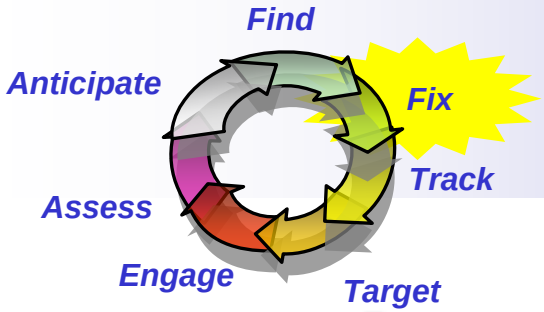
Frequency of Command Interactions
Frequency of Peer-to-Peer Interactions
History
Quality of Interactions
Quality of Peer-to-Peer Interactions
Collaboration about Environment
Command Approach

Rapidly and accurately updated situational understanding as a result of changes in situational awareness

Experience of Personnel
Accuracy
Completeness of Information
Completeness of Individual Information
Completeness of Shared Information
Correctness of Information
Correctness of Individual Information
Correctness of Shared Information
Currency of Information
Currency of Individual Information
Currency of Shared Information
Consistency of Information
Consistency of Individual Information
Consistency of Shared Information
Data Interoperability
Distribution of Information
Extent of Shared Information
Fusion

Information Quality
Information about Forces
Information about Environment
Information about intentions
Information Uncertainty
Network Reach
Precision of Information
Precision of Individual Information
Precision of Shared Information
Relevance of Shared Information
Richness of Collaborative Environment
Share Information
Timeliness of Information
Timeliness of Individual Information
Timeliness of Shared Information
Trust in Information
Uncertainty
Uncertainty of Shared Information

As of May 2005



"Fix" Capabilities

Accurate and timely positive combat identification of ground, air, and space objects

Analyze
Network Availability
Network Reach
Network Reliability
Quality of Communications Equipment
Quality of Computing Equipment
Sensor Coverage (Spacial)
Sensor Coverage (Medium)
Sensor Coverage (Spectrum)
Sensor Persistence

Accuracy of Individual Awareness
Adaptiveness
Awareness about Capabilities
Awareness about Intentions
Task Competence

Accuracy of Collective understanding
Accuracy of Individual Understanding
Collective Knowledge
Completeness of Collective Understanding
Identification
Level of Confidence

Accuracy
Authentication
Completeness of Information
Consistency of Information
Consistency of Shared Information
Correctness of Information
Correctness of Shared Information
Currency of Shared Information
Distribution of Information
Extend of Shared Information
Fusion
Identification
Information About Capabilities

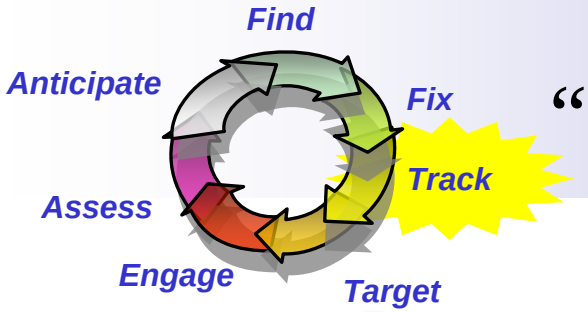
Information Ambiguity
Information Complexity
Information Quality
Information Uncertainty
Precision of Individual Information
Precision of Information
Precision of Shared Information
Relevance of Shared Information
Share Information
Timeliness of Shared Information
Timeliness of Individual Information
Timeliness of Information
Uncertainty of Shared Information

Command Approach
Completeness of Individual Decisions
Mission Effectiveness
Task Competence
Task Speed

High Correlation
Med Correlation
Low Correlation
to
"Fix"

"Track" Capabilities

As of May 2005



Integration and display of operations information in a common operational picture available to entire network

Accuracy *Adaptiveness*
Analyze
Atmospheric Weather
Dynamics across Time
History *Indirect Sensing*
Network Reach *Responsiveness*
Robustness
Accuracy of Shared Information
Completeness of Individual Information
Completeness of Information
Completeness of Shared Information
Consistency of Individual Information
Consistency of Information
Consistency of Shared Information
Correctness of Individual Information
Correctness of Shared Information
Currency of Individual Information
Currency of Information
Currency of Shared Information
Distribution of Information
Dynamics across Time

Accuracy of collective Awareness
Accuracy of Individual Awareness
Accuracy of Intersection Awareness
Accuracy of Partial Awareness
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Completeness of Individual Awareness
Consistency of Individual Awareness
Correctness of Collective Awareness
Correctness of Individual Awareness
Correctness of Partial Awareness
Currency of Collective Awareness
Currency of Individual Awareness
Precision of Individual Awareness
Timeliness of Collective Awareness
Timeliness of Individual Awareness
Uncertainty of Collective Awareness

Accuracy of Collective Understanding
Accuracy of Individual Understanding
Accuracy o f Intersection Understanding
Accuracy of Partial Understanding
Completeness of Collective Understanding
Completeness of Individual Understanding
Completeness of Intersection Understanding
Completeness of Partial Understanding
Consistency of Individual Understanding
Consistency of Intersection Understanding
Consistency of Partial Understanding
Correctness of Collective Understanding
Correctness of Individual Understanding
Correctness of Partial Understanding
Currency of Collective Understanding
Currency of Individual Understanding
Extent of collective Understanding
Extent of Partial Understanding
Shared Understanding
Timeliness of Collective Understanding
Timeliness o f Individual Understanding
Uncertainty of Collective Understanding

Extend of Shared Information
Flexibility
Fusion
Information about Environment
Information about Forces
Information about Intentions
Information Quality
Information Uncertainty
Precision of Individual Information
Precision of Information
Precision of Shared Information
Relevance o f Shared Information
Shared Understanding
Timeliness of Shared Information
Timeliness of Individual Information
Timeliness of Information
Uncertainty of Shared Information

Improve, automate, and streamline monitoring of friendly air and space force location

Adaptiveness
Analyze
Collaboration about Environment
Collaboration about Forces
Collaboration about Intentions
Collaboration about Mission
Command Approach
Distribution of Information
Dynamics across Time
Experience of Personnel

Responsiveness
Risk Propensity
Robustness
Speed of Command
Speed of Decision
Speed of Planning
Synchronization of Decisions
Synchronization of Actions
Task Competency
Task Speed

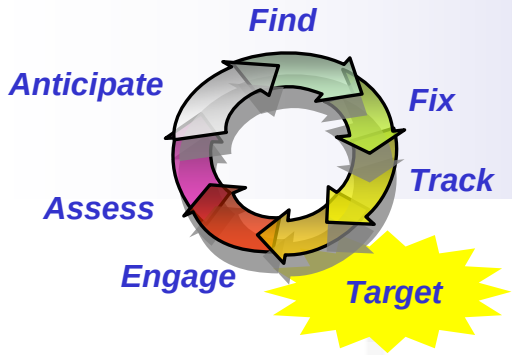
Timeliness of Individual Decisions
Training
Trust in Information
Mobility
Understanding about Environment
Understanding about Forces
Understanding about Intentions
Understanding about Mission
Flexibility

History
Innovation
Level of Confidence
Perception of Cause and Effect
Quality of Decisions
Quality of Plan
Sensor Coverage (Medium)
Sensor coverage (Spacial)
Sensor Coverage (Spectrum)
Space Weather

High Correlation
Med Correlation
Low Correlation
to
"Track"

"Target" Capabilities

As of May 2005



Improve Commander's COA selection and dissemination process

Atmospheric Weather
Direct Sensing
Indirect Sensing
Political Situation
Sensor Coverage (Medium)
Sensor Coverage (Spacial)
Sensor Coverage (Spectrum)
Sensor Persistence
Social Situation
Space Weather

313 – Information about Mission
129 – Information Quality
272 – Information Uncertainty
283 – Precision of Individual Information
133 – Precision of Information
290 – Precision of Shared Information
293 – Relevance of Shared Information
202 – Share Information
294 – Timeliness of Shared Information
284 – Timeliness of Individual Information
134 – Timeliness of Information
89 – Trust in Information
295 – Uncertainty of Shared Information

129 – Completeness of Information
291 – Completeness of Shared Information
282 – Consistency of Information
288 – Consistency of Shared Information
280 – Correctness of Individual Information
287 – Correctness of Shared Information
281 – Currency of Individual Information
131 – Currency of Information
289 – Currency of Shared Information
264 – Data Interoperability
13 – Distribution of Information
286 – Extent of Shared Information
312 – Information about Environment
311 – Information about Forces

Accuracy of Collective Awareness
Accuracy of Intersection Awareness
Awareness about Capabilities
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission

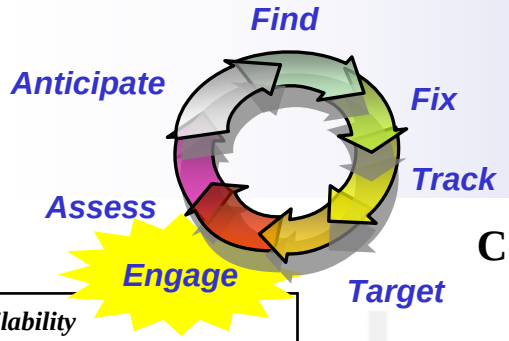
Quality of Decisions
Quality of Plan
Resource Allocation
Resource Prioritization
Responsiveness
Risk Propensity
Robustness
Role of Authority
Skill
Speed of Command
Synchronization
Synchronization of Actions
Task Competence
Task Efficiency
Task Knowledge
Task Speed
Timeliness of Individual Decisions
Training
Uncertainty of Individual Decisions
Willingness

Accuracy of Individual Decisions
Appropriateness o f Individual Decisions
Authentication
C2 Doctrine
Command Approach
Communication of Intent
Constraint Enforcement
Constraint Setting
Control Approach
Criticality
Decision Participants
Degree of Decision Concurrence
Dynamics across time
Experience of Personnel
Flexibility
Force Effectiveness
Identification
Individual Task Efficiency
Lethal Effectors
Likelihood of Success
Mission Effectiveness
Nature of Rules
Non-Lethal Effectors
Political Situation

High Correlation
Med Correlation
Low Correlation
to
"Target"

"Engage" Capabilities

As of May 2005



Better optimized use of the battlespace environment

Atmospheric Weather
Space Weather
Direct Sensing
Indirect Sensing
Communications Interoperability
Complicated-ness
Data Interoperability

Network Availability
Network Reach
Network Reliability
Network Richness
Political situation
Quality of communications Equipment
Quality of Computing Equipment
Selectivity
Social Situation

Conduct real-time effects-based mission execution

Awareness about Capabilities
Awareness about Environment
Awareness about Forces
Awareness about Intentions
Awareness about Mission
Completeness of Individual Awareness
Correctness of Collective Awareness
Currency of Collective Awareness
Currency of Individual Awareness
Shared Awareness (intersection)

Real-time collaboration among all C2 entities

Completeness of Individual Information
Completeness of Shared Information
Correctness of Information
Correctness of Shared Information
Currency of Individual Information
Currency of Information
Currency of Shared Information
Distribution of Information
Extent of Shared Information
Information about Environment
Information about Forces
Information about Intentions
Information about Mission
Information Quality
Precision of Individual Information
Precision of Information
Relevance of shared Information
Timeliness of Shared Information
Timeliness of Information
Trust in Information
Uncertainty of Shared Information

Capability to achieve self-synchronization of forces

Accuracy
Adaptiveness
Authentication
C2 Doctrine
Clarity about roles
Command Approach
Command Arrangements
Communication of Intent
Constraint Enforcement
Constraint Setting
Control Approach
Criticality
Dynamics across Time
Experience of Personnel
Extent of Shared Information
Force Will
Identification
Leadership
Lethal effectors
Level of Confidence
Likelihood of Success
Mission Effectiveness

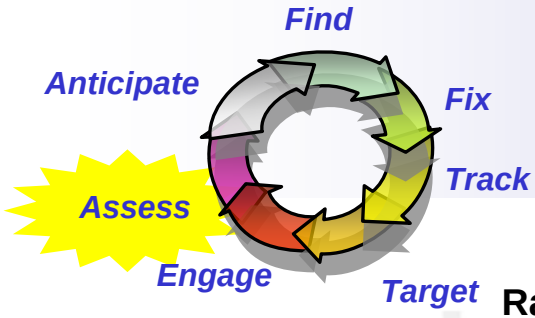
Resource Prioritization
Responsiveness
Role of Authority
Risk Propensity
Robustness
Role of Emotion
Selectivity
Skill
Sleep Deprivation
Social Situation
Speed of Command
Speed of Decision
State of Mental Health
State of Physical Health
Stress Level
Synchronization
Synchronization of Actions
Task Competence
Task Efficiency
Task Knowledge
Task Speed

Completeness of Collective Understanding
Correctness of Collective Understanding
Currency of Collective Understanding
Quality of Understanding
Uncertainty of Individual Understanding
Trust in People
Willingness
Perception of Cause and Effect
Political situation
Resource Allocation
Training
Trust in Information
Mobility
Nature of Rules
Non-Lethal Effectors
Team Culture
Team Decisions

High Correlation
Med Correlation
Low Correlation
to
"Engage"

"Assess" Capabilities

As of May 2005



Real-time Red, Blue Gray force status assessment

Collective Knowledge	*Accuracy of Collective Awareness*
Constraint Enforcement	*Accuracy of Individual Awareness*
Constraint Setting	*Accuracy of Intersection Awareness*
Experience of Personnel	*Accuracy of Partial Awareness*
History	*Awareness about Capabilities*
Identification	*Awareness about Environment*
Lethal Effectors	*Awareness about Forces*
Non-Lethal Effectors	*Awareness about Intentions*
Number of Mental Models	*Awareness about Mission*
Policy Effectiveness	*Completeness of Individual Awareness*
Political Situation	*Correctness of Collective Awareness*
Social Situation	*Correctness of Individual Awareness*
Stress Level	*Correctness of Intersection Awareness*
Team Culture	*Correctness of Partial Awareness*
Team Sensemaking Behavior	*Precision of Collective Awareness*
Uncertainty	*Precision of Individual Awareness*

Ability to accurately assess air and space operational impacts of physical environmental conditions

Accuracy of Shared Information	*Information about Mission*
Completeness of Individual Information	*Information Ambiguity*
Completeness of Shared Information	*Information Complexity*
Correctness of Individual Information	*Information Quality*
Correctness of Information	*Information Uncertainty*
Correctness of Shared Information	*Precision of Individual Information*
Currency of Information	*Precision of Information*
Currency of Shared Information	*Precision of Shared Information*
Extent of Shared Information	*Relevance of Shared Information*
Fusion	*Timeliness of Shared Information*
Information About Capabilities	*Timeliness of Information*
Information about Environment	*Trust in Information*
Information about Forces	*Uncertainty of Shared Information*
Information about Intentions	

Rapid assessment and selection of targets to maximize desired effects

Analyze
Assessment
Constraint Enforcement
Constraint Setting
Discovery
Identification
Innovation
Level of Confidence
Likelihood of Success
Mission Effectiveness
Lethal Effectors
Non-Lethal Effectors
Persistence
Stress Level
Task Competence
Task Efficiency
Task Knowledge
Task Speed

Improve COA evaluation and requirements process

Accuracy of Collective Understanding
Accuracy of Individual Understanding
Accuracy of Intersection Understanding
Accuracy of Partial Understanding
Completeness of Collective Understanding
Completeness of Individual Understanding
Completeness of Partial Understanding
Correctness of Collective Understanding
Correctness of Individual Understanding
Correctness of Intersection Understanding
Correctness of Partial Understanding
Extent of Collective Understanding
Extent of Intersection Understanding
Extent of Partial Understanding
Precision of Collective Understanding
Precision of Individual Understanding
Understanding about Capabilities
Understanding about Environment
Understanding about Forces
Understanding about Intentions
Understanding about Mission

High Correlation
Med Correlation
Low Correlation
to
"Assess"